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Hot Swap

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The process of computer component interchange and how it relates to the life cycle growth within residential architecture.

Hot Swap

By Brian McCracken

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Major: Architecture

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Steve[n] Hardy

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Intent _ _ _

Project Abstract : The current home personal computer allows for the exchange of parts so the user can easily upgrade or repair components as the users needs change. Hot Swapping, is the process of exchanging, upgrade/downgrade components with in a computer while the system is fully operational. The idea of maintaining a complex computer system, while it is fully operational and certain components can be exchanged as needed, has direct applications to the construction of a modern home. Current stick-frame housing techniques for home construction do not easily allow for major changes, or updates to the system, without portions of the system rendered disabled or unusable.

Social : The current housing conditions in the United States shows homes today are oversized for the amount of occupants residing within. These conditions coincide with the life cycle of the occupants. When a family needs more square footage, many choose to move to a large home. This migration to a larger space becomes detrimental when the number of occupants in the home decreases. The remaining members of the family often stay in the residence due to comfort, yet the amount of valuable resources consumed to keep the home livable could be lessened if the occupants could remove the portions of the home.

Technology : The utilization of the Grasshopper plug-in for Rhino allows dynamic control of various constraints and components to be used with a Hot Swap system. By inputting the proper information into the model, selected inputs can be manipulated which produce multiple formal configurations. These configurations, with set constraints, can be rapidly updated to visualize future alterations. With this modeling system in place it is easy for the Hot Swap system to be visualized as it corresponds to the multiple ways it could be upgraded, downgraded, or modified to coincide with the life cycle growth of the occupants.

Assembly : By developing a component system for construction, the idea of the Hot Swapping can be implemented into the construction of a prefab home. The assembly of the Hot Swap system would resemble current SIP panel and modular home construction methods. These methods serve as a precedent for the thesis. The dissimilarity is in the connections, or how the panel connects to other components. The connections are what fulfill the Hot Swap condition. The ability to upgrade / downgrade / replace / repair panels is the driving force for how the system can be modified. Without these connections the panels would be unable to be removed for future expansion or modification. Through the initial design process of the panel, certain characteristics can be implanted so these changes can be achieved in the future.

The housing market in the United States is in a state of demise. With the increase of foreclosures due to the unstable practices on Wall St., many families have to leave their home to due the inability to pay their mortgage. This situation could be alleviated if the process of purchasing a home was similar to leasing an automobile.

When we look at the price of a home 25% of the cost is derived from the value of the land, while another 25% goes directly into the labor associated with the constructing the home. If these two areas could be redefined by using unconventional methods not normally used in residential building practices, then the saving can be put directly into the home buyers pocket.

By developing a leasing system which the home buyer purchases the land, and not the structure; the practice of moving every seven to 10 years could be dissolved. On average the first time home buyer will live in their home for seven to 10 years. This movement can be associated with the growth of the occupants as their lifestyle facilitates an increase in square footage. If the occupants stayed on their current property but upgrade their home, similar to the way one trades in a leased car for a newer model, they could essentially swap out certain components of their home for newer, more efficient components. With the ability to exchange the leased portion of the home the occupant's lifestyle can be flexible to adapting when the situation arises.

Because the modern home has such a close relationship with the occupant's life style, when changes occur problems may arise. This relationship typically allows updates or changes to a home when the occupants lifestyle changes. When these changes to the home are needed, certain areas of the home may be rendered disabled. Areas can become a inconvenience to the user's daily living operations while they are shutdown. By applying Hot Swap techniques used in computers, to modern home construction these inconveniences can be reduced to a simple task.

When we examine the assembled components of a personal computer, attributes with in the system lend themselves to architectural applications for prefab construction. Components are important to the composition of a personal computer and boast important roles in assisting the computer to function. While it is possible for some components to be replaced with other types or styles, the purpose of a personal computer remains fixed; function as an easily adaptable device optimized for individual tasks.
Personal desktop computers currently allow for the exchange of parts or components. This exchange allows the user to easily upgrade components as their needs change, or as advancements in computer technology develop. This exchange, swapping, usually requires a computer system to be powered down so the sensitive components are not harmed during the process. There are three variations of swap: Hot Swap, Warm Swap, Cold Swap.

[H o t S w a p]
An element can be replaced while the rest of the system remains completely uninterrupted. The system carries on functioning, information keeps transferring, and the hardware change is completely transparent.

[W a r m S w a p]
The power remains on to the hardware and the operating system continues to function, but all activity must be stopped to the device connection.

[C o l d S w a p]
The system must be shutdown before making the swap.

A shutdown/swap/reboot operation is easy to accomplish on the personal home computer, due to the small scale of operations and information passing through on a day-to-day basis. Performing shutdown/swap/reboot operations on a large server or datacenter may not be an option due to the type of service being requested from the system. To remedy this problem, certain computer components are able to be Hot Swapped.

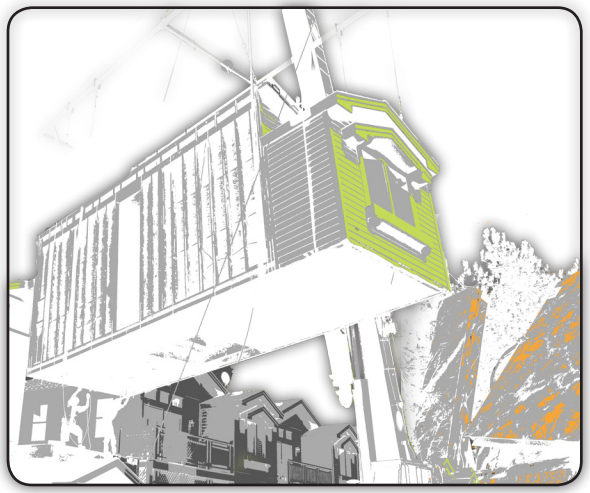
Hot Swapping allows certain computer system components to be changed, upgraded, downgraded, or repaired with in a system without disrupting the computational processes. Maintaining a large, fully operational, complex computer system while exchanging certain components as needed, has direct applications to the assembly and configuration of a modern prefab home. If a prefab system is constructed to facilitate ease in modification, future updates would not require areas of the home to be shutdown.

Prefab architectural components have qualities which can be compared to the components of a personal computer. These qualities stem from the way components in a computer are able to be swapped. The three variations of swap; Hot, Warm, and Cold, correlate to the architectural components by defining how the prefab system will react to the swap.

A Hot Swap operation can be achieved at the disc drive and peripheral devices of a computer because the system is not dependent on the devices. The panel of a prefab assembly is similar in that, the system can continue to function if a panel is removed. Integration of the panel into the other components is paramount for the Hot Swap system to function. The panel will allow the Hot Swap home the flexibility to be easily upgraded, downgraded, or repaired while daily operations continue throughout the home without interference.

The hard disk drive of a computer can be either a Hot Swap or a warm swap, depending on how the drive is installed. If the computer relies on important information on the drive, then the drive would require a Warm swap. This also applies to the structural frame and the module assembly, which depending on how the configuration is arranged would dictate different swap conditions. The relationship between the module and frame depends on the design of the Hot Swap home, which would dictate the proper swap to be used.

The case, motherboard, and power supply unit of a computer are cold swap components due to the total shutdown of the system. This total shutdown of the system, as it relates to the prefab architectural components, is similar to the necessary steps needed to upgrade or repair the foundation system and service core. This classification sets constraints for the way the architectural assembly will be constructed. Certain components once set with in the system will require complete shutdown to be modified.



HOT SWAP
proposal
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Computer Assembly

Precedent Studies

Prefab Architectural Components

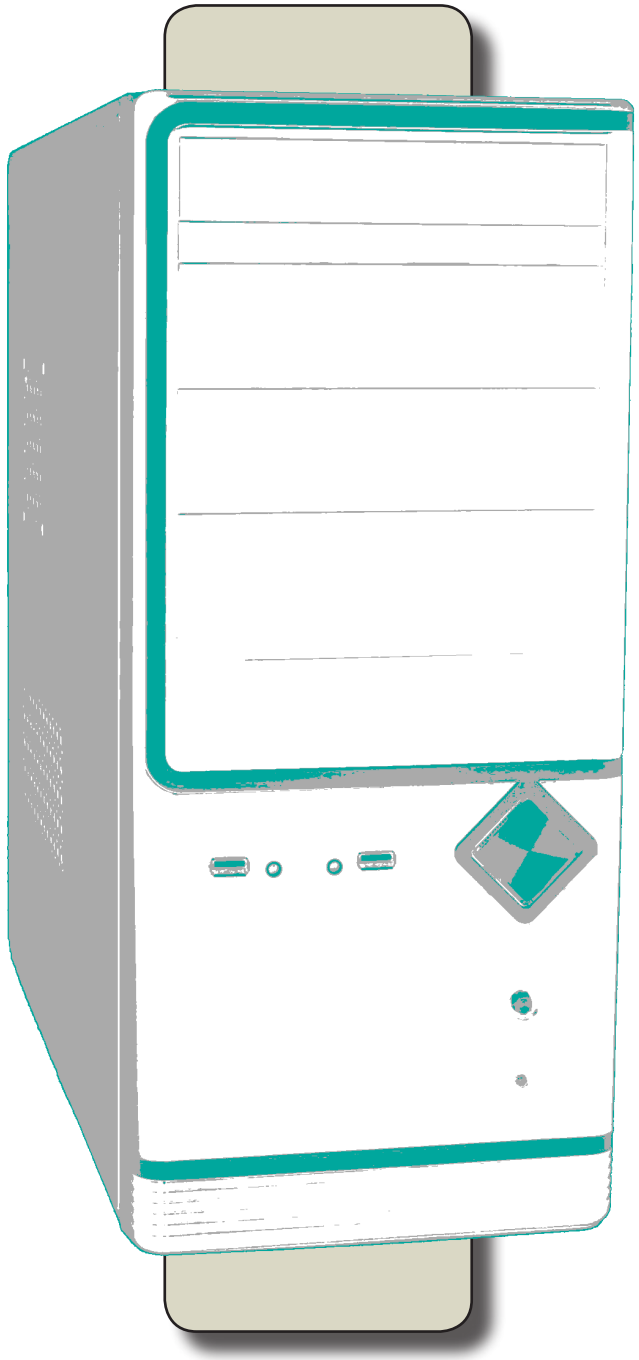
Prefab Assembly Types

Configuration & Customization

Social Time-line

Hot Swap

analysis



The Case

The case provides a body, housing, or structure to place components in, and serves to protect the various components from harm. While various styles of cases exist on today's market all have the same purpose, just different ways to store the various components. Some cases are designed to optimize the removal of heat generated from the electronic components. Others are designed to facilitate optimal use of space, reduction of noise which ultimately is consumer preference of the design of their system.

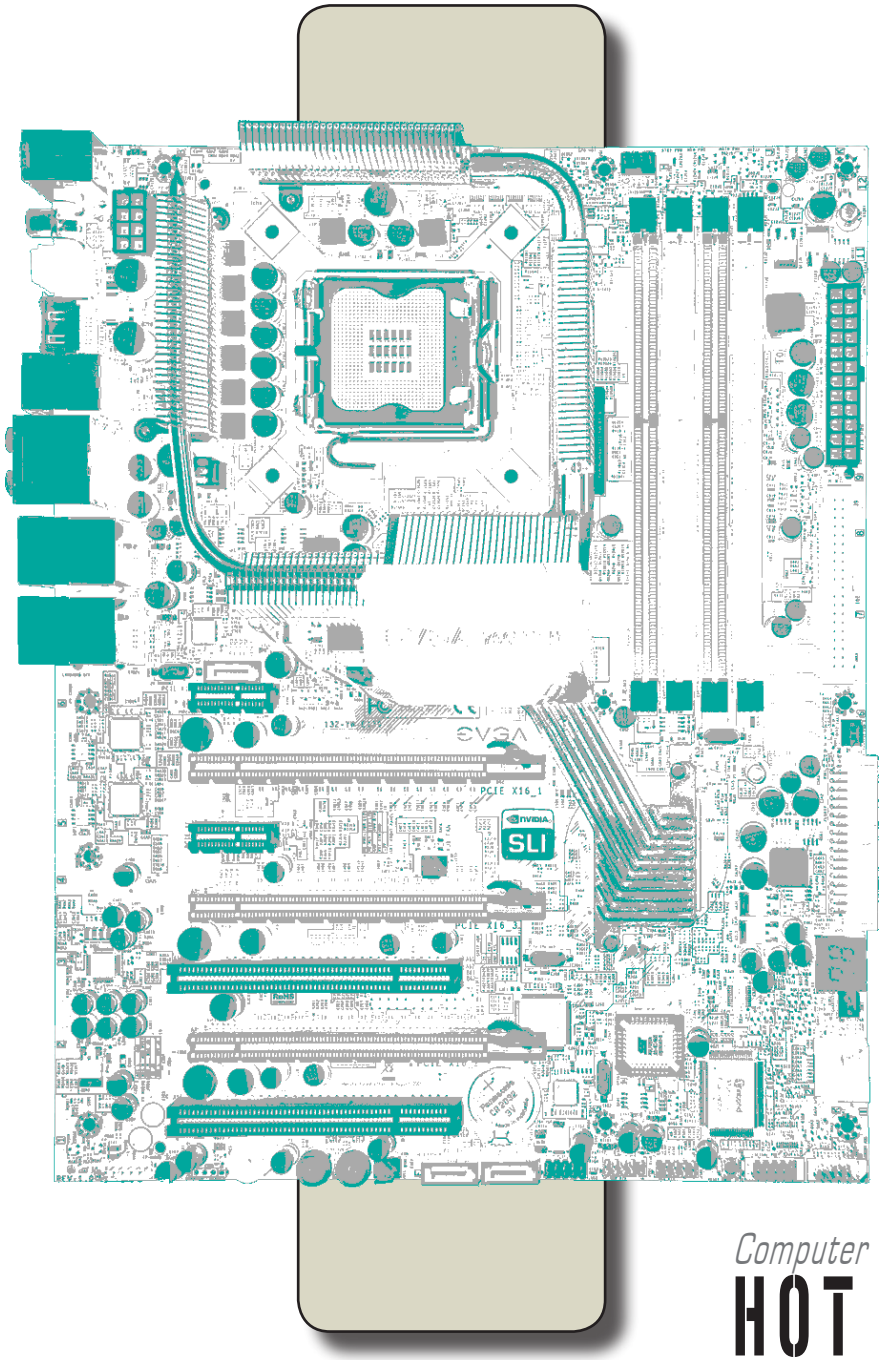
Since the case houses all the necessary components it makes it virtually impracticable to keep a system running safely outside of the case. For this reason the case produces conditions which are not suitable for swapping while the system is operational.

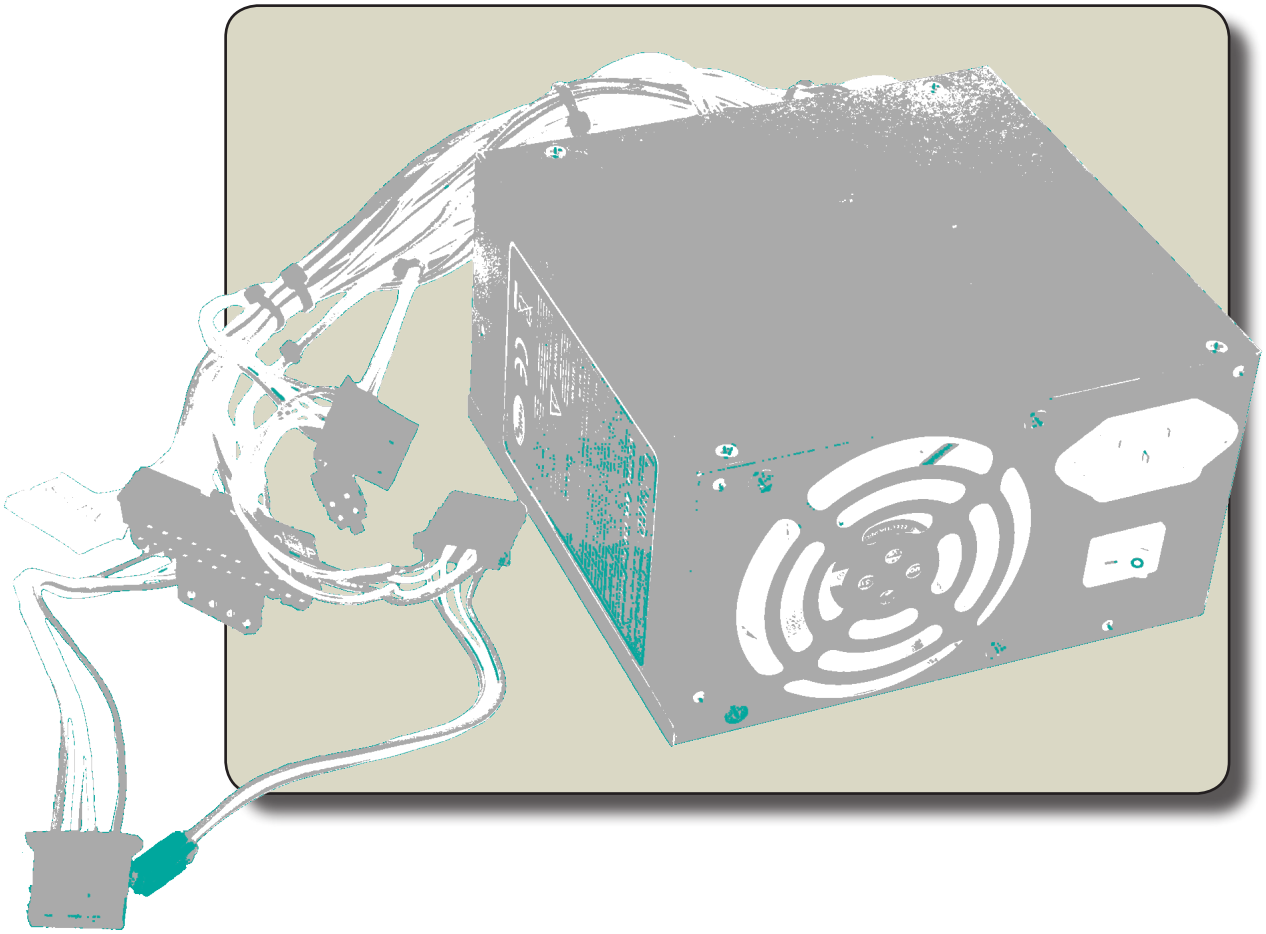
Motherboard

The motherboard is the docking platform for all components within the system. All information from the components is routed through the various channels within the motherboard, without the motherboard this information would not pass through. On the motherboard resides a location for specific components.

The Central Processing Unit (CPU) is the brain of the computer, processing and routing necessary information to run the system. The CPU draws it processing power from the Random Access Memory (RAM), which aids in running the configuration at high speeds. This information is produced in the visual form through the Graphic Processing Unit (GPU).

All of these components reside in specific locations on the motherboard, and these components must remain in their fixed location for the computer to function properly. Removal of the motherboard is only possible if all electrical current to the system is stopped and the previous components are removed. In this instance the motherboard is unable to facilitate a swappable condition without rendering the system unusable.





PSU

The Power Supply Unit (PSU) provides the computer with the necessary electrical current to power the system. Without the PSU the computer would be a collection of components without a function. PSU's are multi-facetted controllers which power all necessary components with specific amounts of voltage. Cable end connectors are site specific to certain locations on different components within the computer.

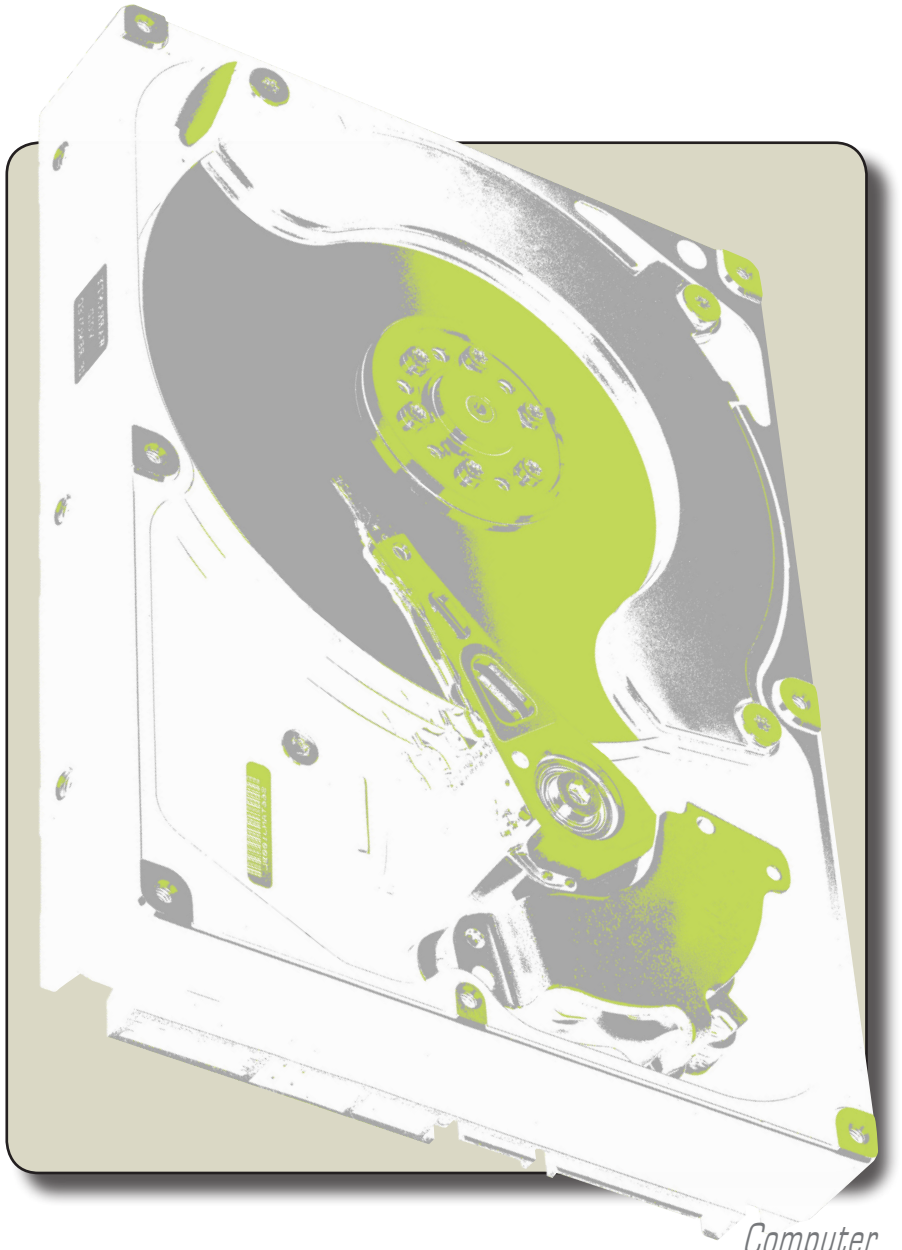
If the PSU is removed from the system, all operations would cease to exist. For this reason the PSU produces conditions which are not suitable for swapping while the system is operational.

HDD

The Hard Disk Drive (HDD) allows the computer to store and retain data so it may function according to the user's specifications. Without a HDD the computer would be deficient in the ability to store data to run the components, along with an assortment of applications.

The HDD pulls all the components together by providing a location to store information before it is passed to the required locations with in the system. HDD's are one of the few mechanical parts within a computer, which makes it susceptible to failure due to wear and tear of the drive. Also, since the HDD receives and stores data it is possible for corrupt data to infiltrate the system and render the system unusable.

If multiple HDD's are installed in a specific configuration, it is possible for a HDD to be removed from the system while it is fully operational. Yet, there are some instances where is not possible such as the HDD storing the operating system running the computer.



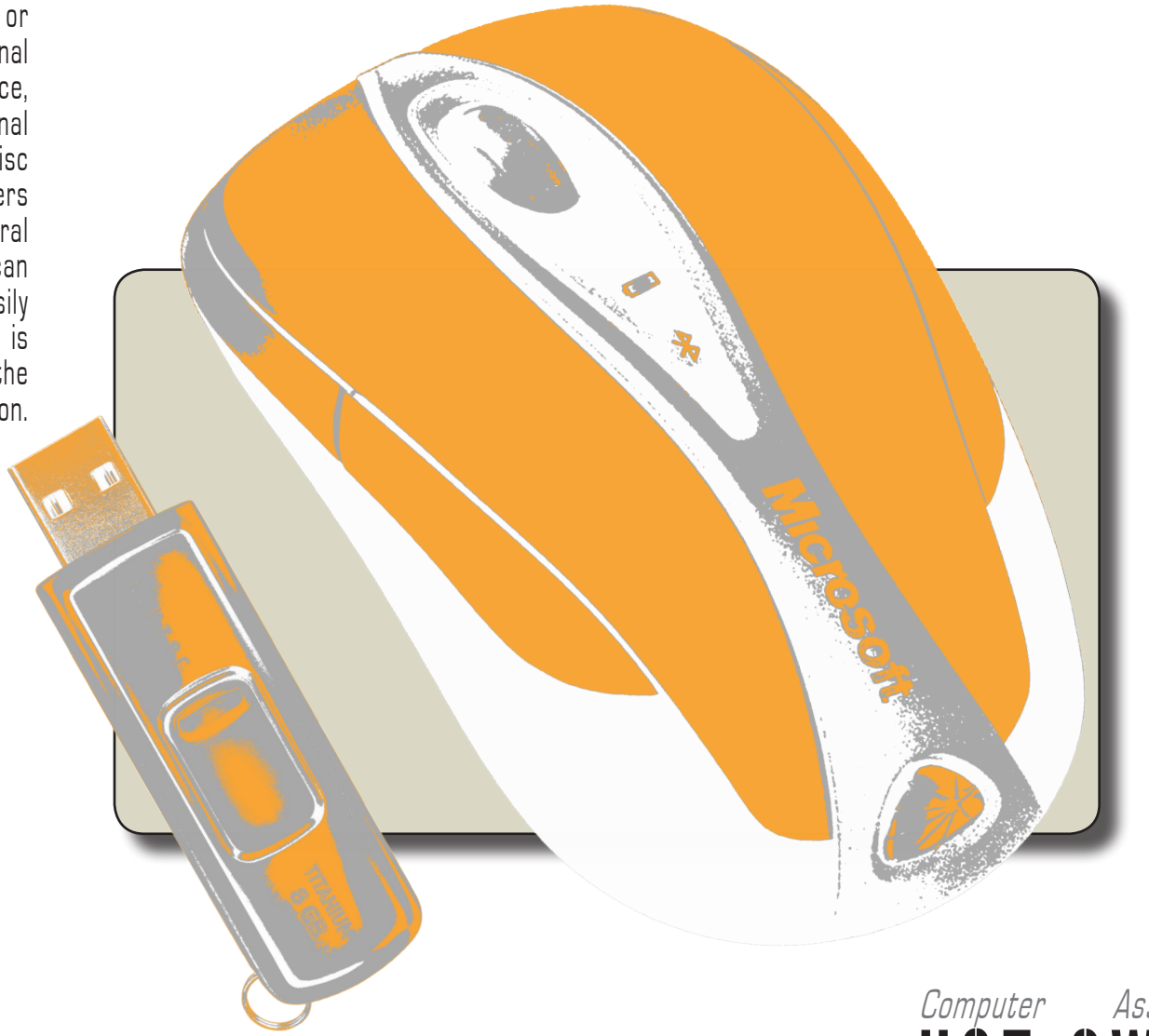
Disc Drives

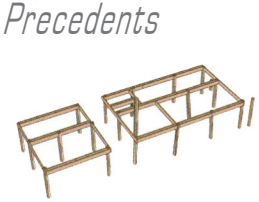
The disc drive is a mechanical device which reads data from and writes data onto a disk. This provides a gateway for information to be loaded and unloaded from the system. It is possible for a computer to not have a disc drive, but this would make certain operations difficult.

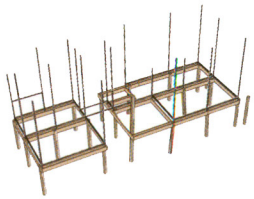
Disc drives are often located within the case, but there are options available to have an external device if one so chooses. Since disc drives are a peripheral component, it is possible to remove them from the computer system while the system is fully operational. This allows the disc drive to be swapped if needed.

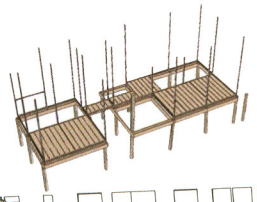
Peripheral Devices

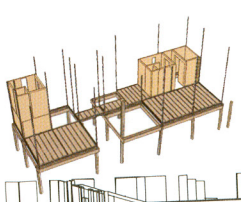
Peripheral devices are attached to a computer but are considered not part of the system, due to its primary functionality is dependent upon the system. Therefore they can be considered as expanding the computer's capabilities, while not forming part of the system. These devices are often powered by the computer, or require an external power source. Mice, flash drives, external hard drives, disc drives, and printers are all peripheral devices, and can be swapped easily since the system is not reliant on the device to function.

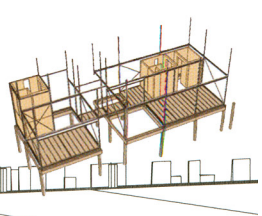


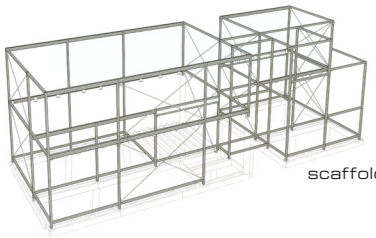


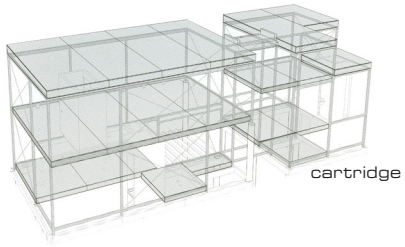


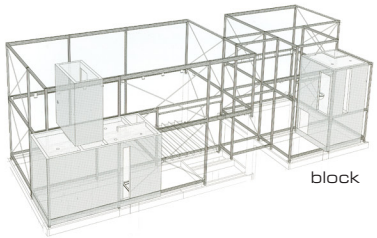


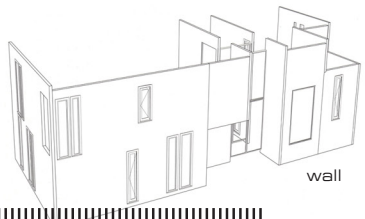


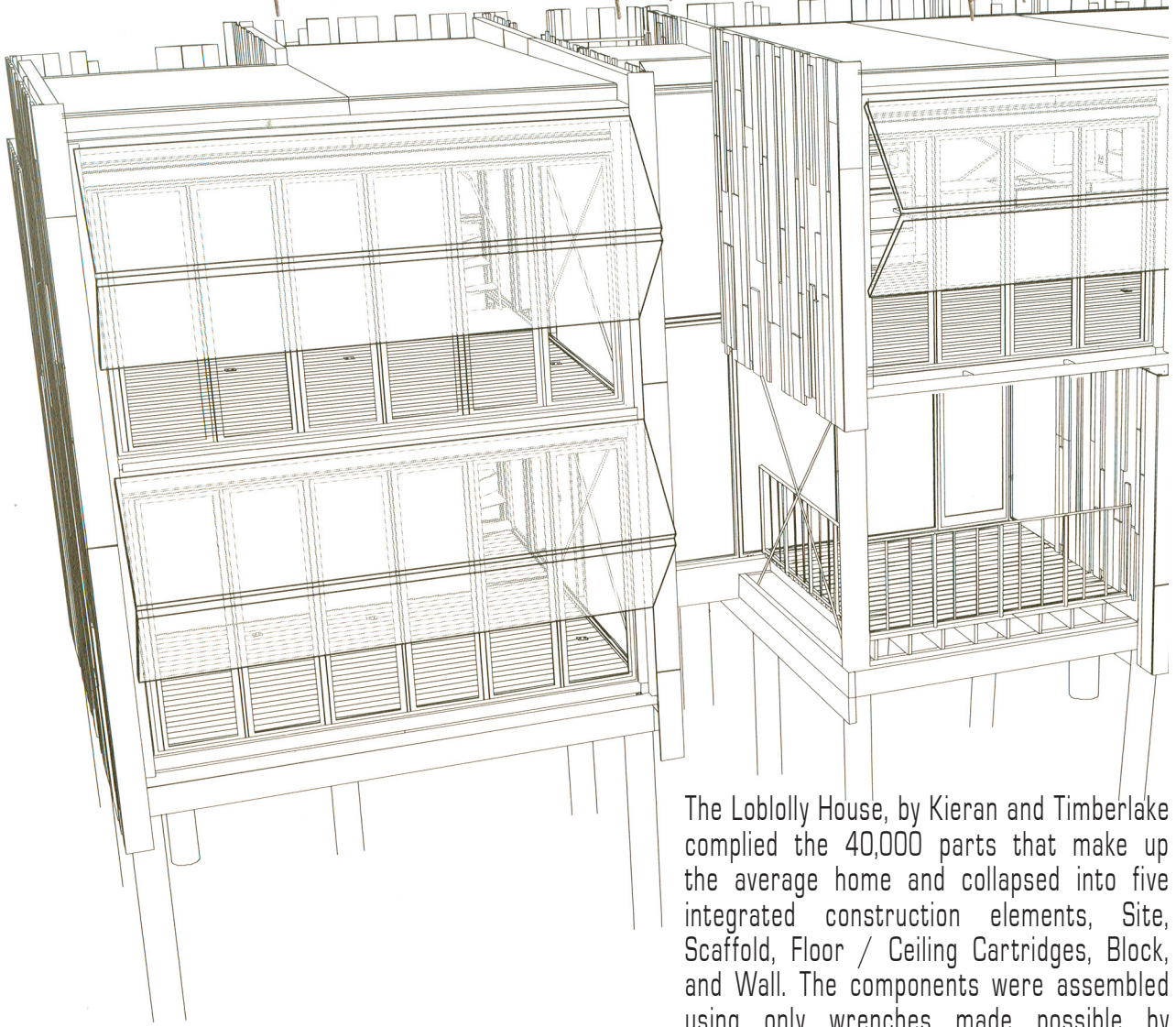




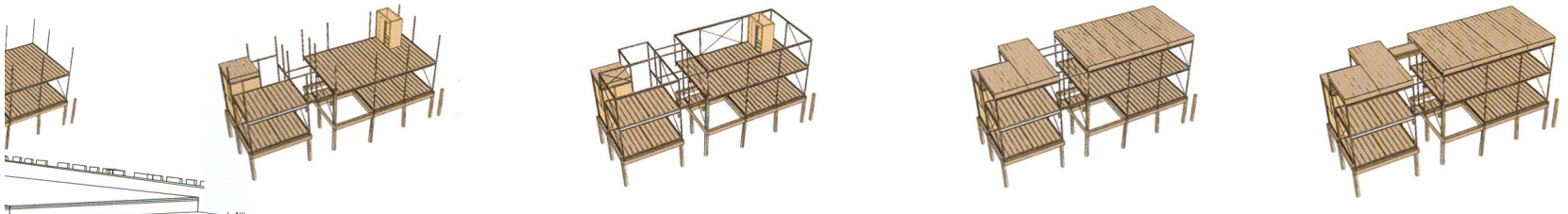


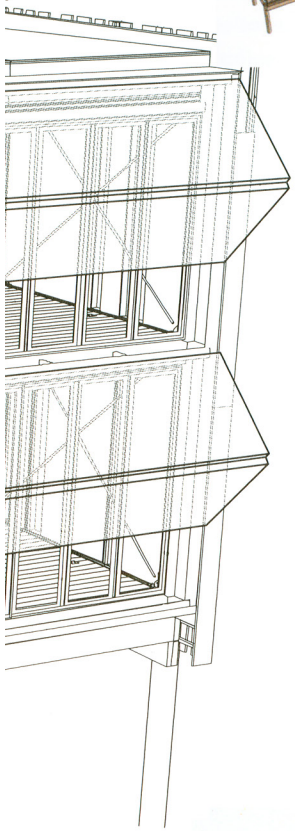


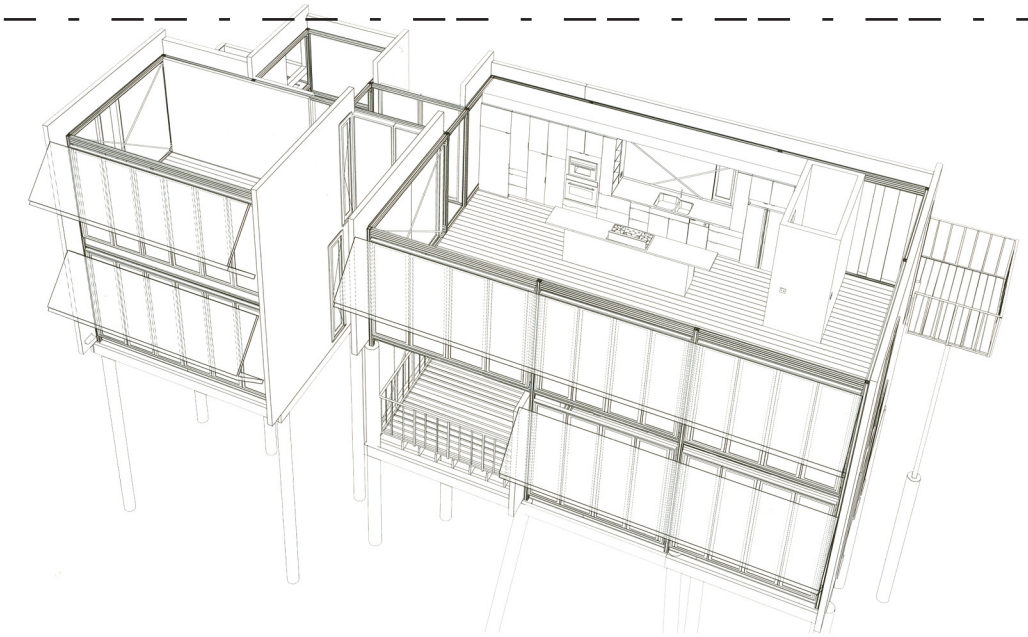




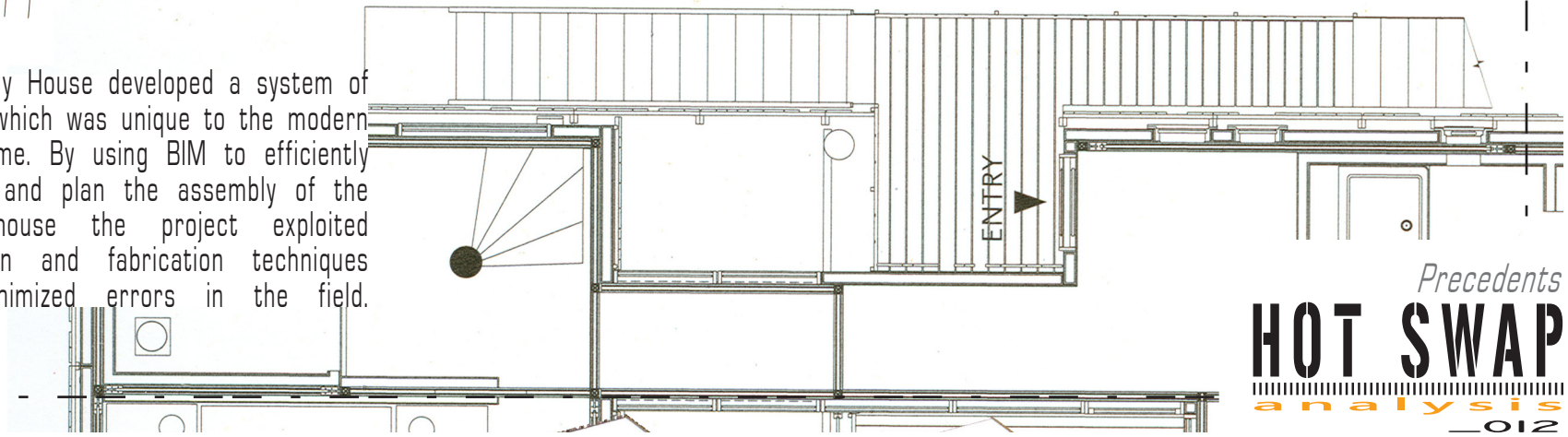
The Loblolly House, by Kieran and Timberlake complied the 40,000 parts that make up the average home and collapsed into five integrated construction elements, Site, Scaffold, Floor / Ceiling Cartridges, Block, and Wall. The components were assembled using only wrenches made possible by the file-to-factory design system in place.

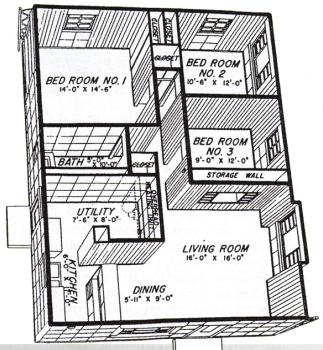


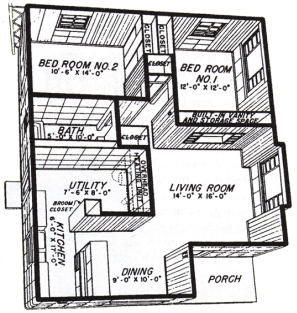




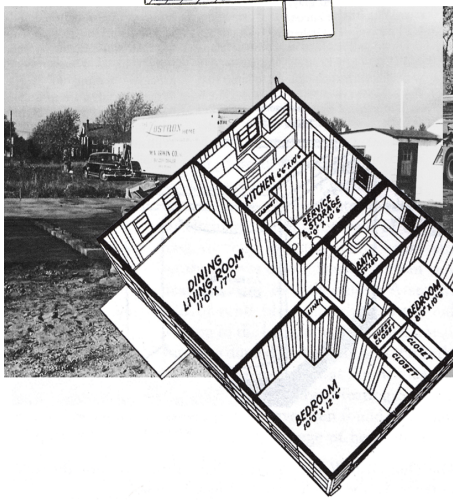
The Loblolly House developed a system of assembly which was unique to the modern prefab home. By using BIM to efficiently document and plan the assembly of the Loblolly house the project exploited the design and fabrication techniques which minimized errors in the field.

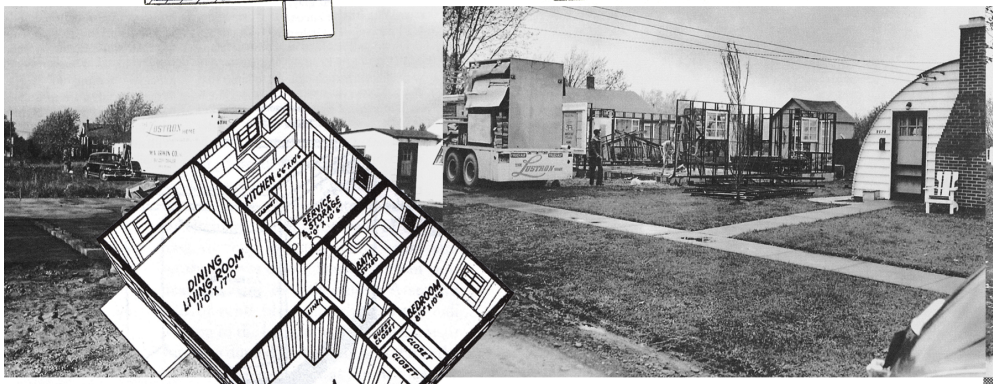


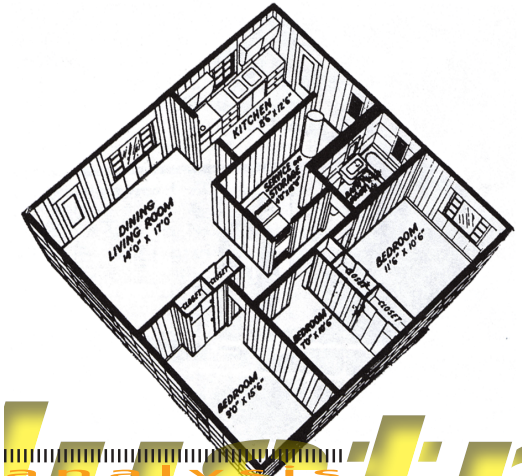


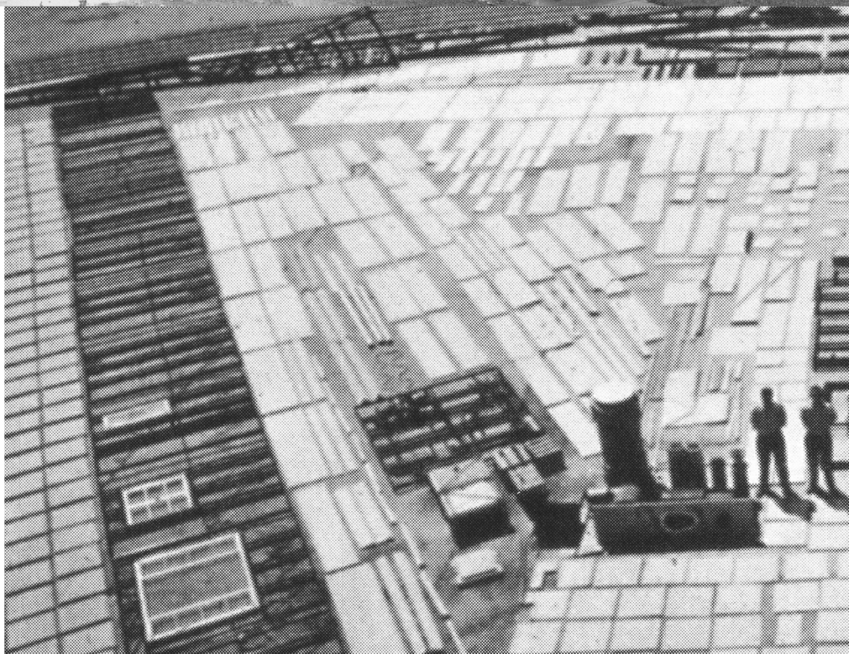


In January 1947, the Lustron Corporation announced that it had received a 40 million dollar Reconstruction Finance Corporation loan to manufacture mass-produced prefabricated homes. The homes were to be constructed from steel, which at the time was though to be a cheaper alternative to the wooden mass-produced homes.

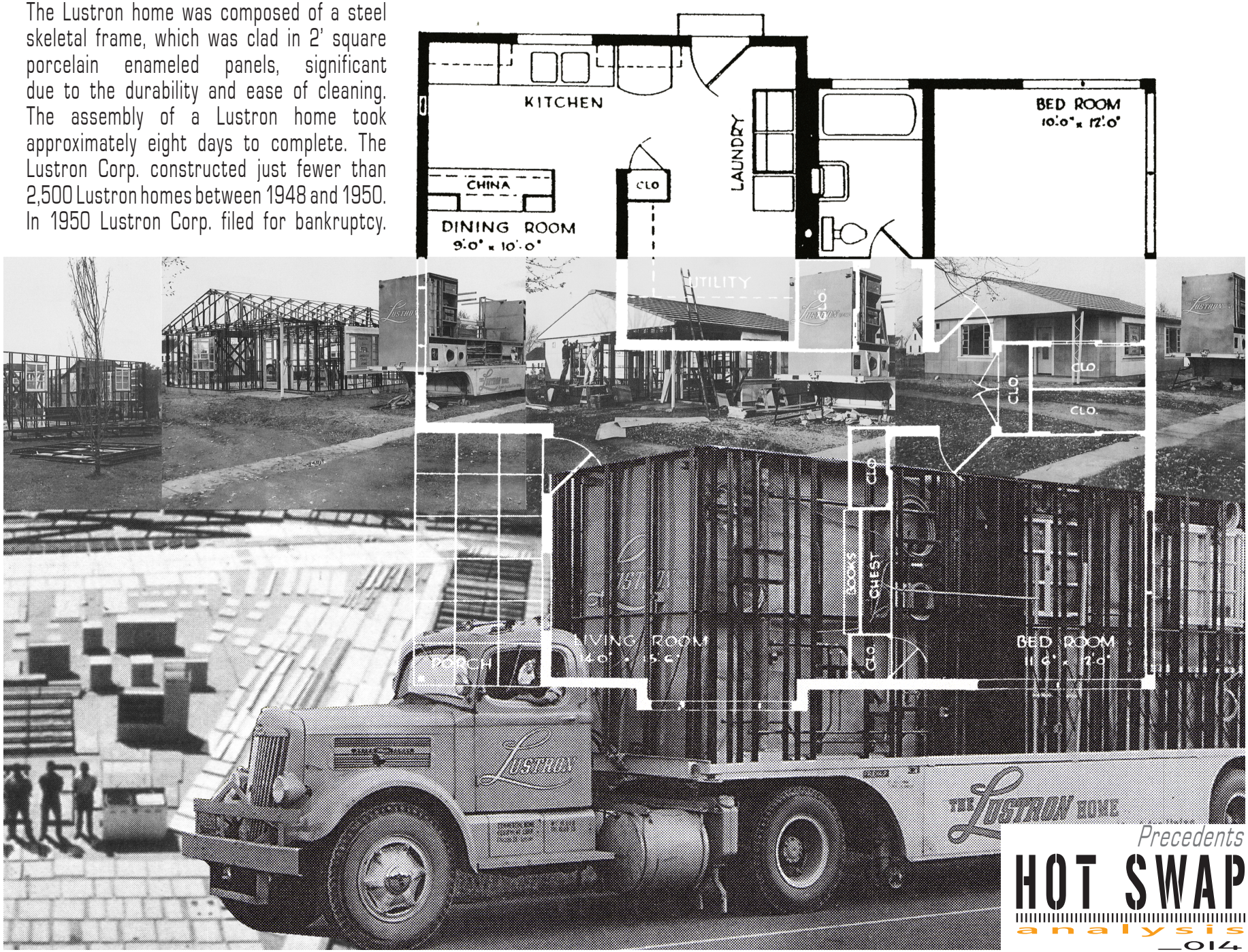




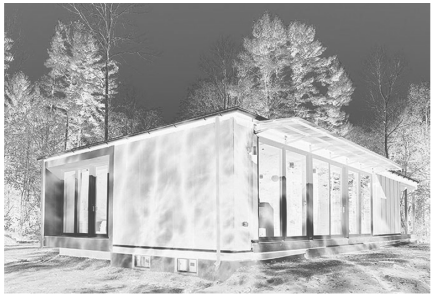


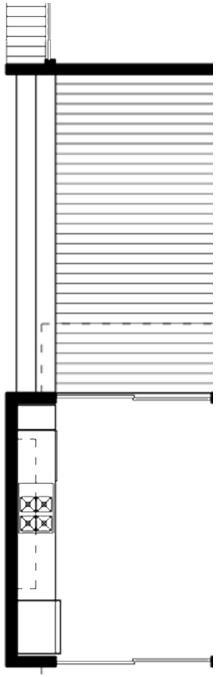


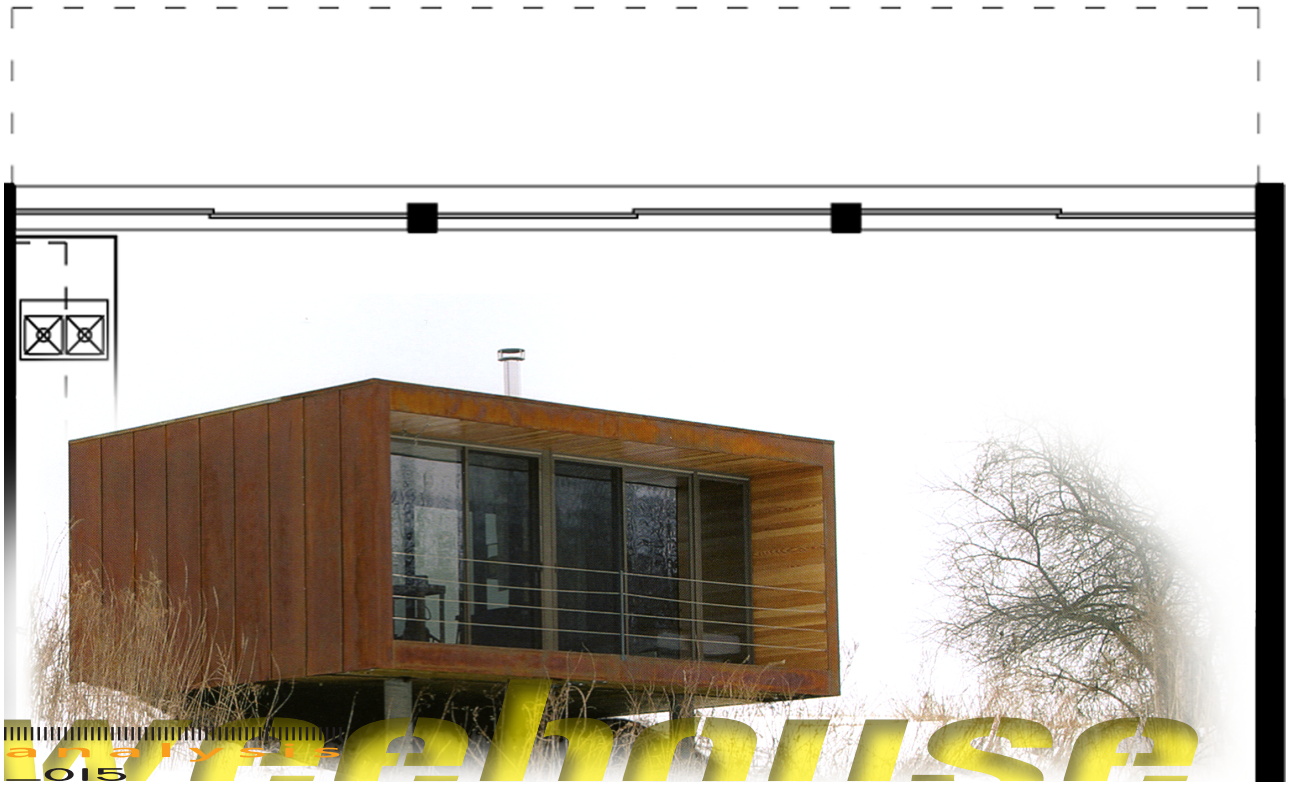
The Lustron home was composed of a steel skeletal frame, which was clad in 2' square porcelain enameled panels, significant due to the durability and ease of cleaning. The assembly of a Lustron home took approximately eight days to complete. The Lustron Corp. constructed just fewer than 2,500 Lustron homes between 1948 and 1950. In 1950 Lustron Corp. filed for bankruptcy.



Precedents

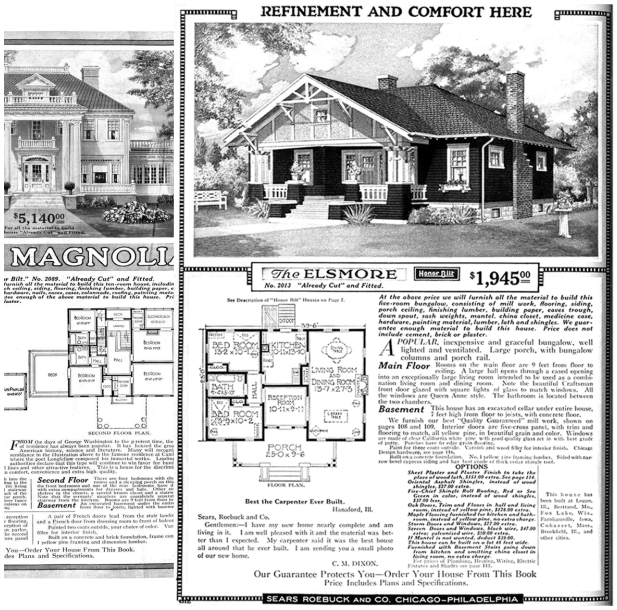






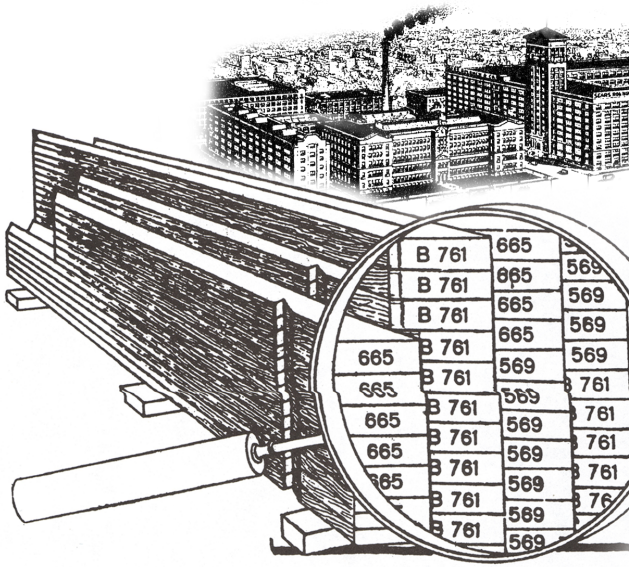
The weeHouse is a modular system which can be customized to serve as a home, office, addition or rooftop structure. The flexibility of the design is developed from a base modular size. This module, when scaled and repeated, develops multiple configurations which construct larger modular units.

The customizable modular unit allows flexibility in all aspects of design. Utilization of sustainable products aids in producing a smarter, efficient prefab home. The modular unit is 15 - 20 % cheaper than a home with similar square footage.



From 1908 to 1940 over 100,000 kit homes were sold through the Modern Homes mail order catalogue. Over 447 different designs were developed by Sears's designers. Characteristics of the homes were diverse, ranging from straightforward one-room structures to intricate multi-family multistory units. These designs were not groundbreaking, yet they fulfilled the needs of the consumer; focusing on hardware, appliances, finishes, and furnishing sets.

The diversity in clients allowed for Sears to develop three different levels of home lines relative to their quality: Honor-Bilt, Standard Built, and Simplex Sectional. The Sears homes were innovative for the time period through the use of drywall and asphalt shingles, and for introducing central heating for residential use. By utilizing the railroad to transport the materials to the consumer resulted in a majority of the homes can be found near the rail lines.



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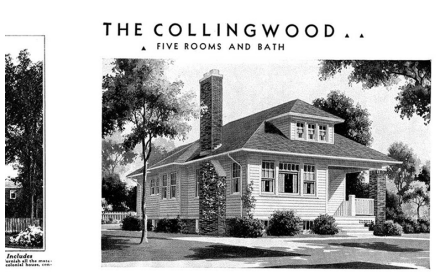


THE COLLINGWOOD

▲ FIVE ROOMS AND BATH

MODERN HOME
No. 3280
ALREADY CUT AND FITTED
PRICE $149.00

FLOOR PLAN

▶ Page 42 ◀ 643

HERE is an unusual bungalow, well suited for modern living conditions. The exterior is very practical and finds much favor on account of its simplicity. The lines of the hip roof are broken by the dormer on the front and bay projection over the dining room at the side. Living out of doors, as most of us do in summer, the front porch will be appreciated. The windows are very well designed and attractively arranged.

The Living Room. From the front porch we enter the living room, which is 12 ft. 9 in. wide by 18 ft. 5 in. deep. None the convenient and attractively designed fireplace in the left wall, on each side of which is a window, and the triple window in the front wall.

The Dining Room. The dining room is located next to the living room and is lighted by two large windows contained in the bay projection.

The Kitchen. From the dining room we pass into the kitchen where considerable thought has been given to the placing of many built-in features and practical arrangement of other equipment. The kitchen sink is located underneath the double window on the left wall, on each side of which suitable kitchen cabinets are furnished at option prices. A place for brooms, mops, etc., is formed by the closet opening off the right wall. The built-in breakfast alcove occupies the space at the rear. Table and seats for this furnished at option price.

Bedrooms. A plastered arch is used in the opening between the dining room and hall which connects the two bedrooms and bath.

WHAT OUR PRICE INCLUDES

At the price quoted, we guarantee to furnish all material consisting of lumber, lath, millwork, flooring, shingles, building paper, hardware, metal and painting materials according to specifications. See attached price list for options.

Modern Homes Division

The Garfield

Honor Bilt
No. C2223 "Already Cut" and Fitted
$2,639.00

THE GARFIELD two-story twin apartment home is considered a splendid investment opportunity. It can be sold at a reasonable profit in any fairly good locality. Sometimes the owner lives in one apartment and rents out the other to a tenant. Such rental usually pays the cost of the property.

The Garfield has a pleasing exterior and a modern interior, with no waste of space. "Honor Bilt" material and construction are additional features that assure the utmost in value.

FIRST FLOOR

Private Entrances. The first floor apartment as well as the second floor apartment has a private entrance on the spacious front porch. Size of porch, 16 feet by 8 feet.

The Living Room. Size, 12 feet 8 inches by 11 feet 2 inches. Wall space for furniture and pictures. Light and cheerful. Has a pleasing fireplace effect.

The Dining Room. 12 feet 8 inches by 10 feet 7 inches. A wide easel opening connects the living room with the dining room. Has double window at side.

The Kitchen. From the dining room a swinging door leads into the kitchen, which is 8 feet 4 inches by 8 feet 8 inches. The kitchen has sanitary linoleum floor covering, and has a large range and table for the workers.

The kitchen has a built-in ventilator.

The Bedrooms. Right of the dining room is a bedroom 10 feet 7 inches by 10 feet 7 inches square. Each bedroom has a clothes closet. The front bedroom has one window, and the rear bedroom has two windows.

The Bathroom has a built-in medicine case.

SECOND FLOOR

Stairs lead up from the front porch to the hall on the second floor. All rooms are planned the same as on the first floor. Has one bathroom, which is larger and has three windows.

Read first floor description for details.

BASEMENT

Room for a furnace for both apartments or a furnace for each apartment. Has cement floor throughout.

Height of Ceilings. First floor, 8 feet 6 inches from floor to ceiling. Second floor, 8 feet 6 inches from floor to ceiling. Basement, 7 feet from floor to joists.

What Our Price Includes

At the price quoted we will furnish all the material to build this two-family house, consisting of mill work, lumber, lath, Fire-Chief Shingle Roofing, porch ceiling, siding, flooring, finishing lumber, building paper, eaves trough, down spout, sash weights, hardware and painting material. We guarantee enough material to build this house. Price does not include cement, brick or plaster.

Tiles, Bath & Kitchen Floors, Kitchen Wainscot, Colonnade Case, Vestibule Floor, Windows, Cabinets, Mantels, Stairs, Doors, Trim, Finish, Floors, Ceilings, Plastering, Roofing, Porches, Gutters, Leaders, Lath, Sheathing, Sash, Frames, Weights, Hardware, Paint, Heating, Plumbing, Wiring, Electric Fixtures, Shades, Screens, Cement, Brick, Plaster, Sand, Lime, Hair, Labor, Contractor's Profit, Overhead Expenses, Insurance, Taxes, Interest, Etc., Etc.

OPTIONS

Sheet Plaster and Plaster Finish to take the place of wood lath, $138.00 extra. See page 114.
Cement floor in basement, instead of wood floor, $17.00 extra.
Oak floors, Trim and Floors in living room, dining room, instead of yellow pine, $184.00 extra.
Maple Flooring for kitchen, pantry and bathroom, instead of yellow pine, no extra charge.
Storm Doors and Windows, black wire, $17.00 extra. Galvanized wire, $20.00 extra.
Screen Doors and Windows, black wire, $27.00 extra. Galvanized wire, $30.00 extra. Bronze wire, $37.00 extra.
Clear heart cypress siding instead of stucco, $55.00 extra.

Our Guarantee Protects You—Order Your House From This Book.
Prices Includes Plans and Specifications.

For Our Easy Payment Plans See Pages 2 and 3. For Our Information Blanks See Pages 123 and 124.

FOUR ROOMS, BATH AND PORCH

The HATHAWAY

Honor Bilt
No. 3092 "Already Cut" and Fitted.
$1,299.00

At the price quoted we will furnish all the material to build this four-room cottage, consisting of mill work, lumber, lath, Fire-Chief Roofing, porch ceiling, siding, flooring, finishing lumber, building paper, eaves trough, down spout, sash weights, hardware and painting material. We guarantee enough material to build this house. Price does not include cement, brick or plaster.

AMERICAN tourists in Europe are always greatly impressed by the cottage homes of England. They speak enthusiastically of the artistic appearance of the thatched roof and describe them as covered with vines and climbing roses. Most of these English homes are constructed of brick or stone, and while the thatched roofs of the style of architecture in Europe cannot be made to closely resemble the original by the aid of stucco and shingles, the Hathaway, as shown in the illustration, is a modern adaptation of the English cottage and while not as picturesque, its roof is far more economical as comparatively small cost. The ornamental trellised porch with its rustic columns, the leaded glass windows and the colonial windows with their many lights are the true type of house at home in any American community. The tiled floor of the vestibule, the panelled wainscot of the dining room which are artistic examples of interior decoration will amaze. Vines or ivy on the trellis and side walls will transform this cottage into a veritable bower.

First Floor A door from the trellised porch leads into the good size living room in which there is a fireplace with mantel. Adjoining the living room is the dining room with panelled wainscot, plate rail, buffet, reading lamp, chairs and other necessary articles of furniture. Two doors lead from the dining room, one to the side porch and the other into the kitchen which has the popular breakfast alcove, lighted by a good sized window. The kitchen is fitted with a sink and cupboard directly under the window. There is also space for the kitchen table which will be placed at or three in alcove of space for work and the breakfast alcove is handy to the range and sink. The rear door opens on the back porch.

Second Floor Up hall on this floor. Bathroom has shelves for towels. Both bedrooms are a good size and each has a clothes closet. Bedroom at front has two windows, the one at rear has one window. Bedrooms are 8 feet 2 inches from floor to ceiling.

Basement Excavated basement under the entire house, 7 feet from floor to joists, lighted with basement sash.

We furnish our best "Quality Guaranteed" mill work, shown on pages 108 and 109.
Cement floor in basement, instead of wood floor, $17.00 extra.
Oak floors, trim and floors in living room and dining room, instead of yellow pine, $184.00 extra.
Maple flooring for kitchen, pantry and bathroom, instead of yellow pine, no extra charge.
Storm Doors and Windows, black wire, $36. extra; galvanized wire, $40.00 extra.
This house can be built on a lot 25 feet wide.
Clear heart cypress siding instead of stucco, $55. extra.

Price for three coats outside, one shade of color, Varnish and wood filler for interior finish. Stradivari Design hardware, see page 117.

Built on a concrete and brick foundation No. 1 yellow pine framing lumber. Sided with bevel siding. Floor, Red Shingle Roll Roofing, guaranteed for seventeen years.

For prices of Plumbing, Heating, Wiring, Electric Fixtures and Shades, see page 115.

Our Guarantee Protects You—Order Your House From This Book.
Prices Includes Plans and Specifications.

SEARS, ROEBUCK AND CO. CHICAGO-PHILADELPHIA

FIVE ROOMS~NEAT PORCH

The Clyde

Honor Bilt
$1,298.00 No. 3020 "Already Cut" and Fitted
1,175.00 No. 7020 "Already Cut" and Fitted

At the prices quoted we will furnish all the material to build this five-room cottage, consisting of mill work, lumber, lath, Fire-Chief Shingle Roll Roofing, porch ceiling, siding, flooring, finishing lumber, medicine case, building paper, eaves trough, down spout, sash weights, hardware, enamel and painting material. We guarantee enough material to build this house. Prices do not include cement, brick or plaster.

Kitchen showing cabinets we furnish with No. 9035

STUCCO panels and tapered columns, brackets and other little touches make the Clyde an unusually well balanced and attractive home which will look as well on a narrow lot as on a wide one.

Main Floor Entering the living room, it is surprising to find how large and light it is. It extends entirely across the house and has three windows, one at the front and two with a nook on each side of the back wall. It is of such good shape and arrangement that no matter what pieces of furniture you have, they can always be comfortably and attractively arranged. The wide cased opening into the dining room adds to the light and the feeling of spaciousness. Here you have the two windows pouring light right over the table. Opposite is a big space that will accommodate a buffet.

The kitchen is an unusually compact, convenient workroom. Standing at the sink you are close to the window and the table. The grade entrance is a modern convenience that will be appreciated. Between the kitchen and the dining room is a serving shelf which saves many steps and makes the kitchen easier to keep.

There is a closet off each bedroom. The bathroom in Plan No. 9040 is between the bedrooms. Rooms are 9 feet from floor to ceiling.

Basement Excavated basement under the entire house 7 feet from floor to joists, lighted with basement sash.

We furnish our best "Quality Guaranteed" mill work, shown on pages 108 and 109. Interior doors are five-cross panel, with trim and flooring to match, all yellow pine, in stained effect and color. Windows are made of clear California white pine with good quality glass set in with best grade of putty.

Paint for three coats outside, one shade of color. Varnish and wood filler for interior finish. Stradivari Design hardware, see page 117.

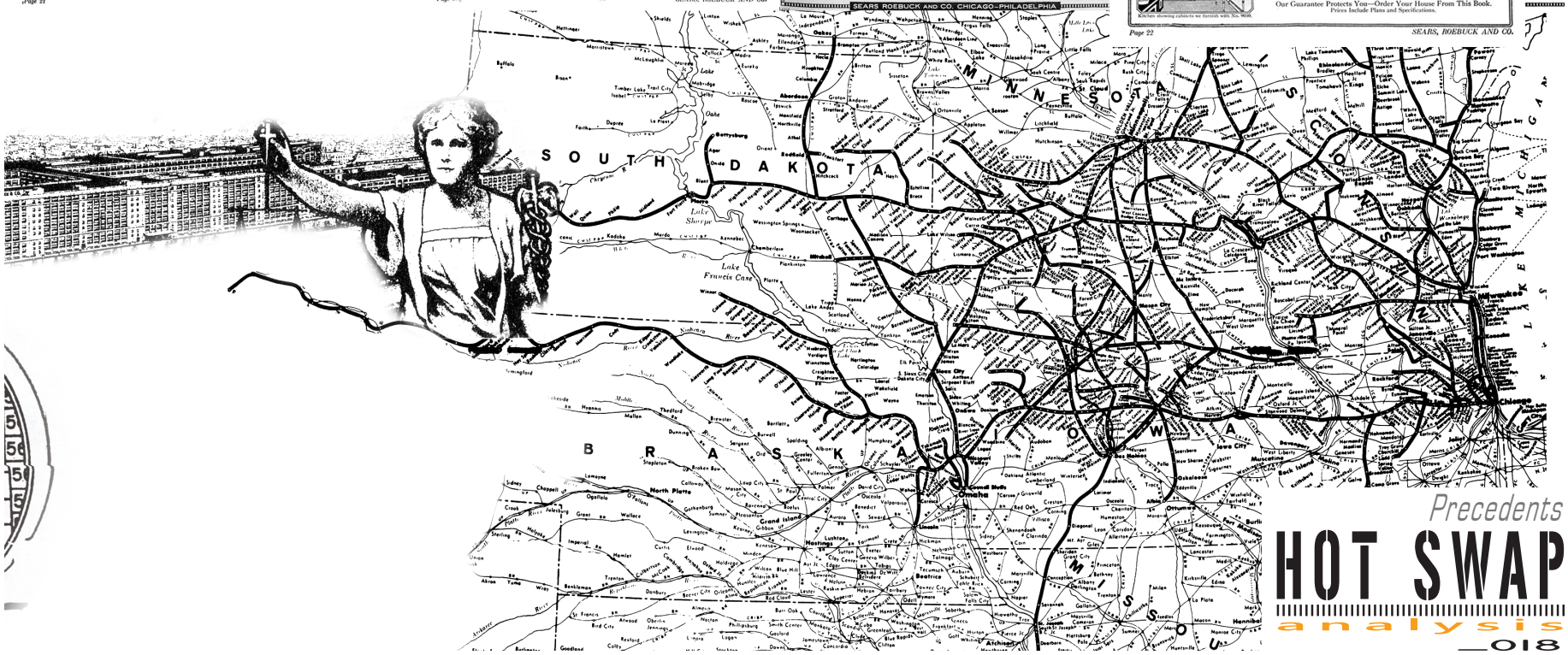
Built on a concrete foundation. No. 1 yellow pine framing lumber. Clear cypress siding. Roofed with Fire-Chief Shingle Roll Roofing, guaranteed seventeen years.

OPTIONS

Sheet Plaster and Plaster Finish, instead of wood lath, $91.00 extra for No. 7020 and $106.00 extra for No. 9020. See page 114.
Oak Floors, Trim and Floors in living room and dining room, instead of yellow pine, $124.00 extra.
Maple Flooring for kitchen, pantry and bathroom, instead of yellow pine, no extra charge.
Storm Doors and Windows, black wire, $17.00 extra. Galvanized wire, $20.00 extra. Bronze wire, $27.00 extra for No. 7020 and $30.00 extra for No. 9020.
Clear heart cypress siding instead of stucco, $37.00 extra for No. 9020; galvanized wire, $30.00 extra; for No. 7020 and $31.00 extra for No. 9020.
Asbestos shingles covered, Architect $12.00.
This house can be built on a lot 26 feet wide.

For prices of Plumbing, Heating, Wiring, Electric Fixtures and Shades see page 115.

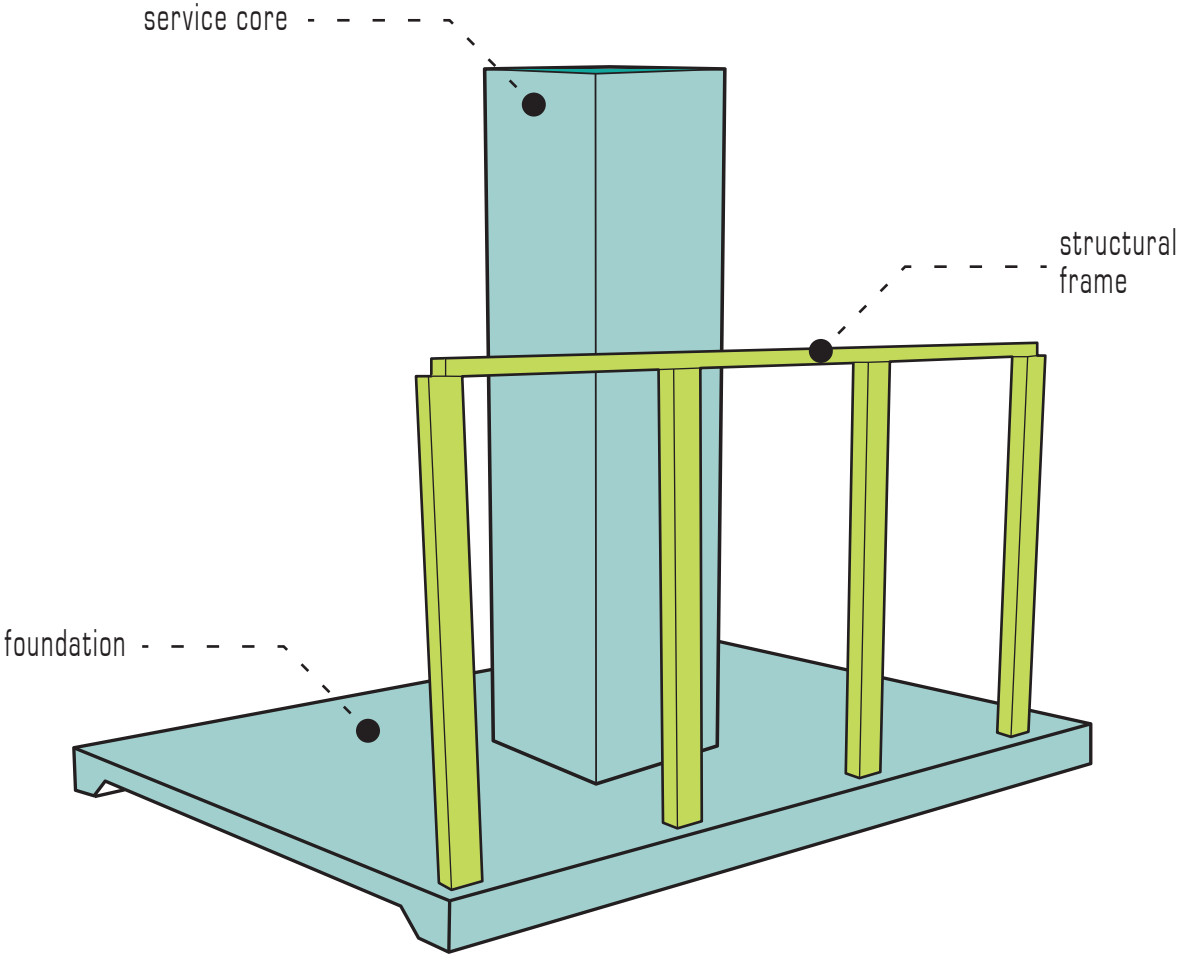
Our Guarantee Protects You—Order Your House From This Book.
Prices Include Plans and Specifications.

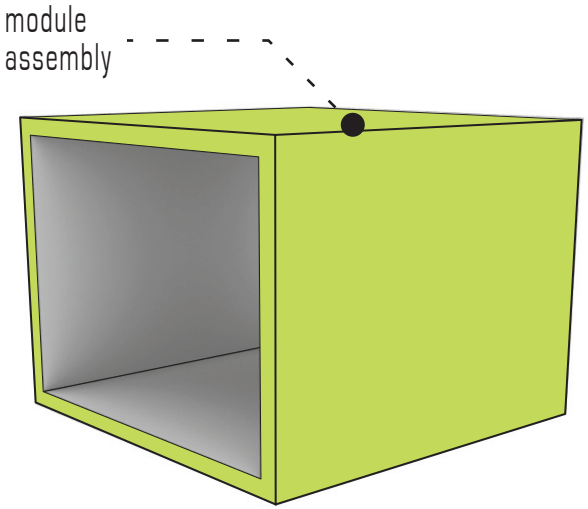


Precedents
HOT SWAP
analysis
_018

[*Cold Swap*]
The total shutdown of a computer system, as it relates to the prefab architectural components, is similar to the necessary steps needed to upgrade or repair a structural column grid, foundation system or service core. This classification sets constraints for the way the architectural assembly will be constructed. Certain components once set with in the system will require complete shutdown to be modified.

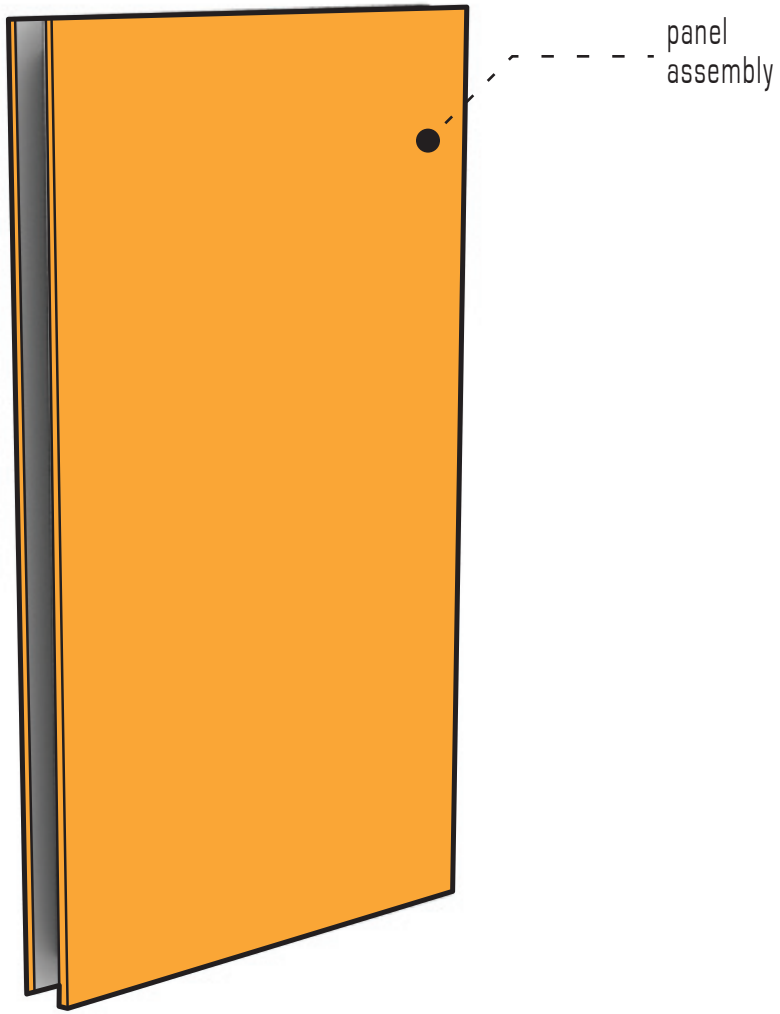
[*Warm Swap*]
The structural frame and the module assembly, which depending on how the configuration is arranged dictate which different swap conditions would apply.





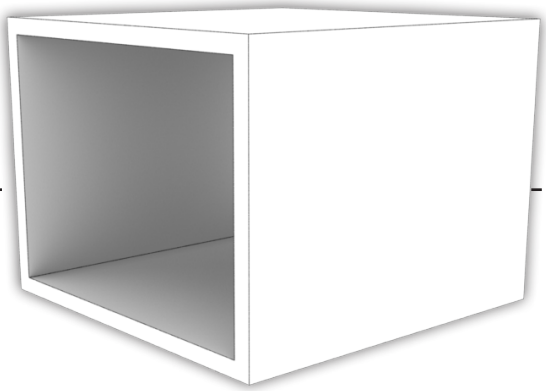
[*Hot Swap*]
The panel of a prefab assembly is similar in that, system can continue to function if a panel is removed. Integration of the panel into the other components is paramount for the Hot Swap system to function.

The panel will allow the Hot Swap home the flexibility to be easily upgraded, downgraded, or repaired while daily operations continue throughout the home without interference.



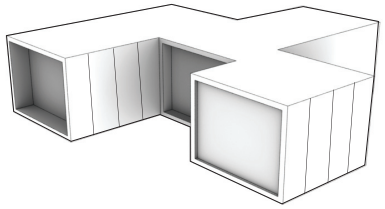
The *integrated system* is a panel assembly. The panel fulfills the function of the framework and enclosure. Since this panel contains structure, removal of this panel may provide difficult if it is used as a load bearing. A panel by itself is obsolete; once multiple panels are introduced it is possible to develop spatial arrangements.

The *separate system* is a structural frame and panel assembly. The panels can be attached and removed from the structural frame without disrupting the system. With panels removed, it is possible to access the frame. The separate assembly can develop spatial arrangements through the linking of multiple assemblies.

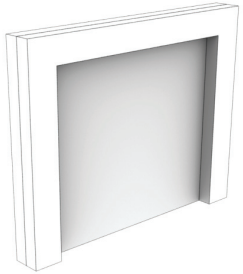


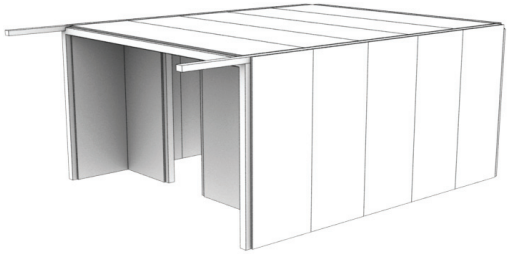
The *module system* is an factory assembled component comprised of panels. This application is useful when specific spatial configurations can be pre-assembled. Due to the nature of installing a module, the system may be interrupted for a short period of time. If the module is an addition then the downtime may not exist.

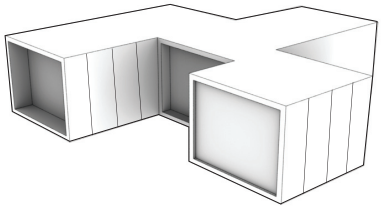
Integrated system



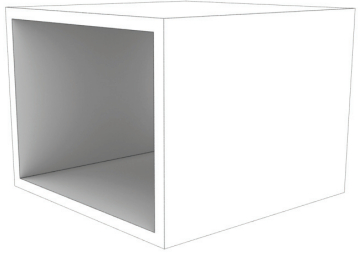
Separate system

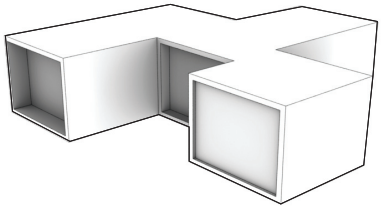






Module system





Pre Fab Assembly Types

HOT SWAP

analysis

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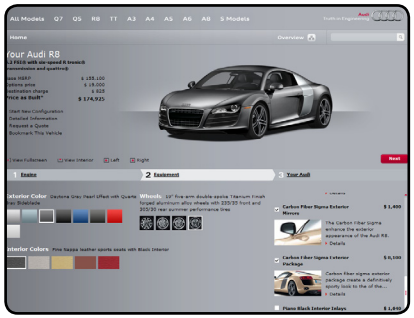
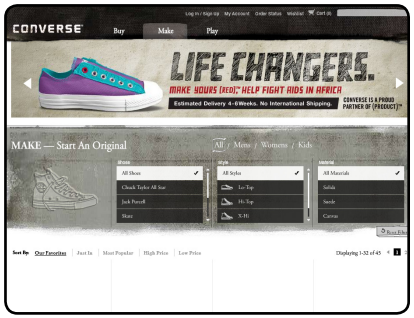
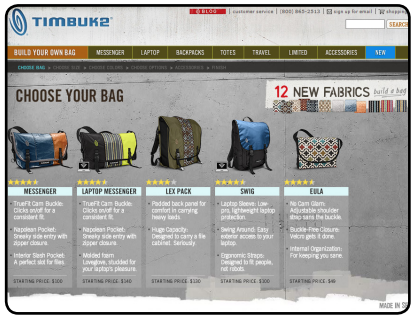
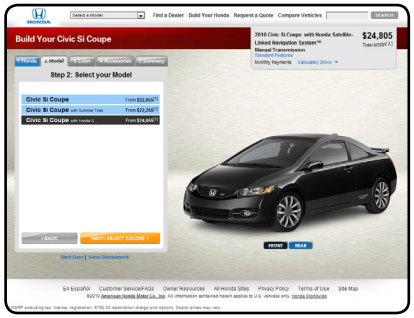
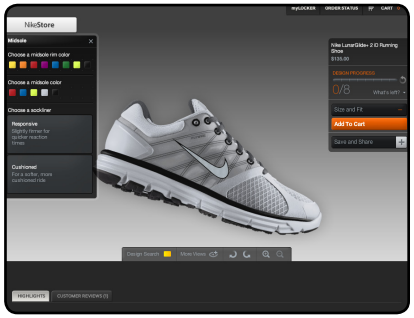
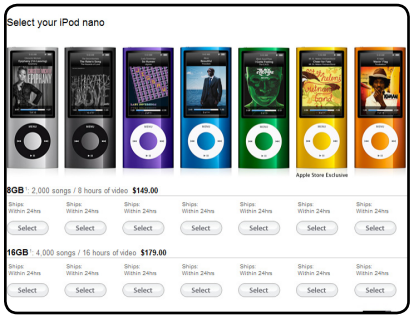






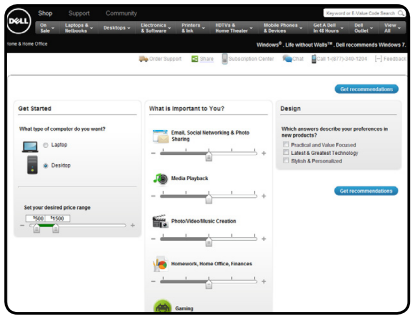


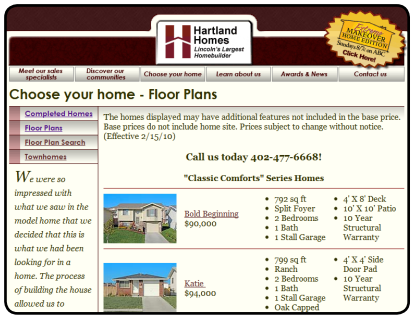


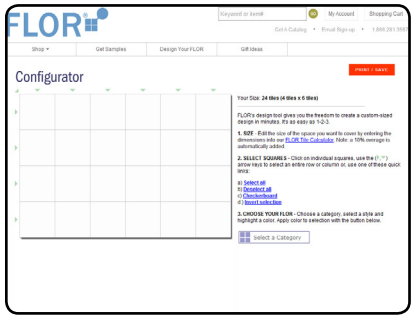


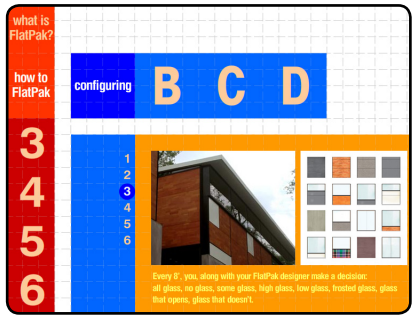
Current trends in consumer customization show the application of a base being modified by the consumer; cars, clothing, computers, electronic gadgets, architectural building components, and residential homes give the consumer multiple options to apply to a base model.

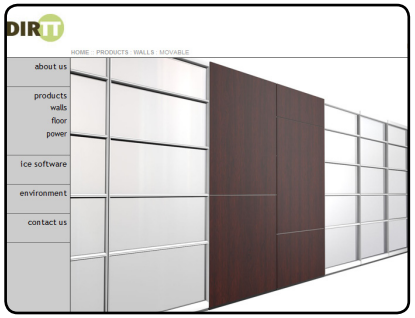
These personal specifications are inputted into the system and calculated accordingly. The end result is the a personalized product; the consumer feels the satisfaction of designing a product suited to his/ her style. This application of personal input into a base model allows a variety of individualized products to be created.

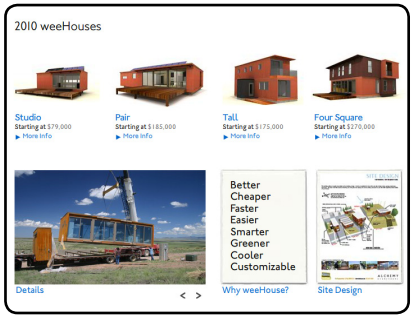


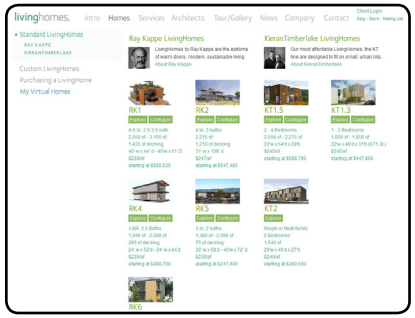


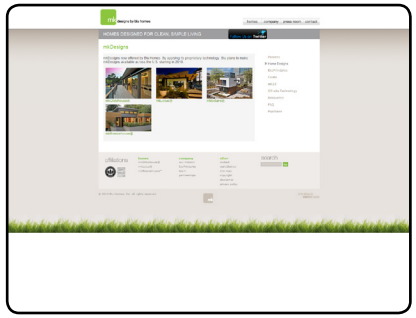












base product + personal specification = individualized product

individualized product

Configuration & Customization

HOT SWAP social

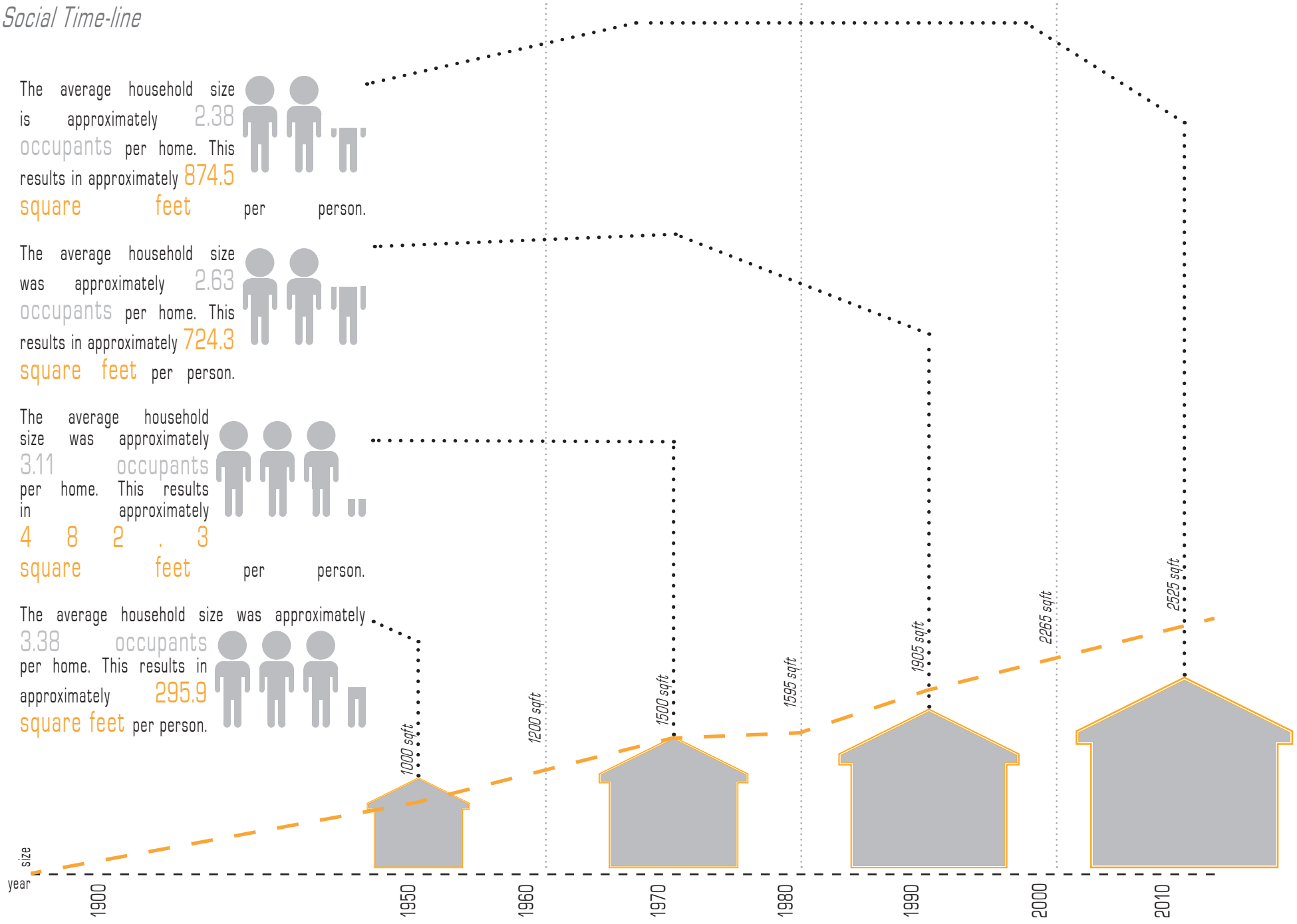
2024

The average household size is approximately 2.38 occupants per home. This results in approximately 874.5 square feet per person.

The average household size was approximately 2.63 occupants per home. This results in approximately 724.3 square feet per person.

The average household size was approximately 3.11 occupants per home. This results in approximately 482.3 square feet per person.

The average household size was approximately 3.38 occupants per home. This results in approximately 295.9 square feet per person.



Growth of the Average Home over the last 100 Years

The family life cycle is in direct correlation with the progression of square footage as it relates to American housing. An increase in family size often leads to an increase in square footage needed to live comfortably. To gain this needed space two options exist; move to a larger home or update the current residence.

Many Americans move to a larger home. This larger home accommodates the larger family until the time presents itself for members to depart the home. When occupants leave the home the square footage once needed to live comfortably, becomes wasted space consuming energy and resources. Many choose to stay in the home they have come to enjoy so that if the extra space is needed, it is available.

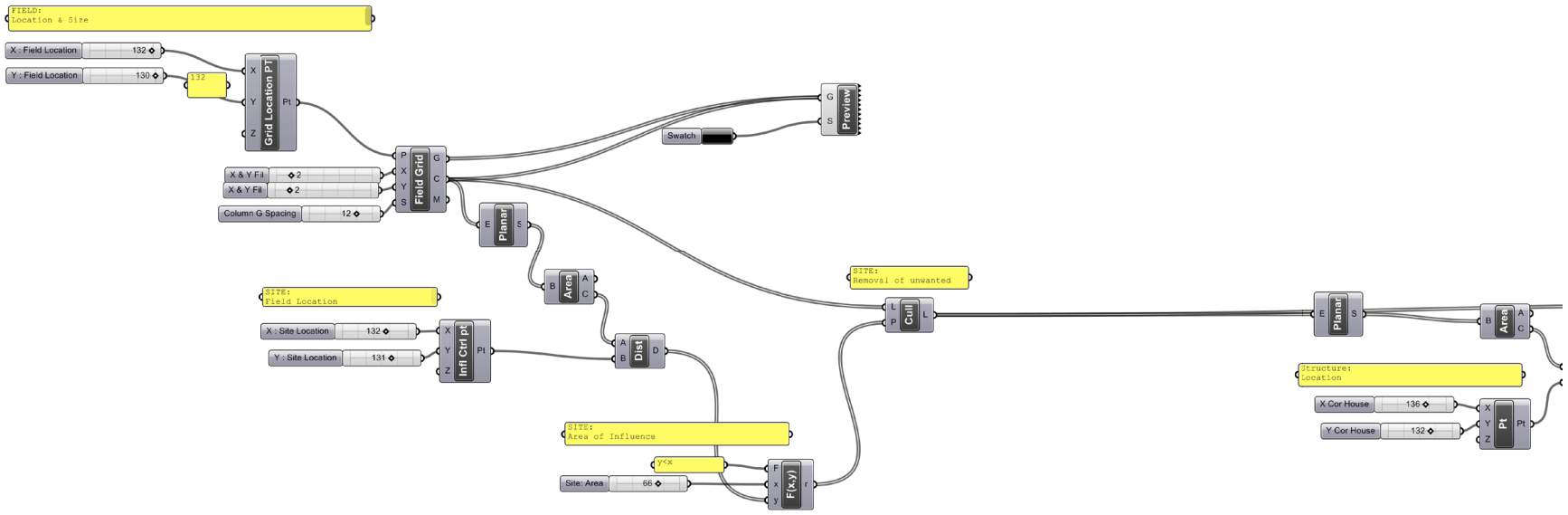
If it was possible to upgrade or downgrade as the occupants lifestyle required, would the problem of wasted space within the home disappear?

Grasshopper Integration

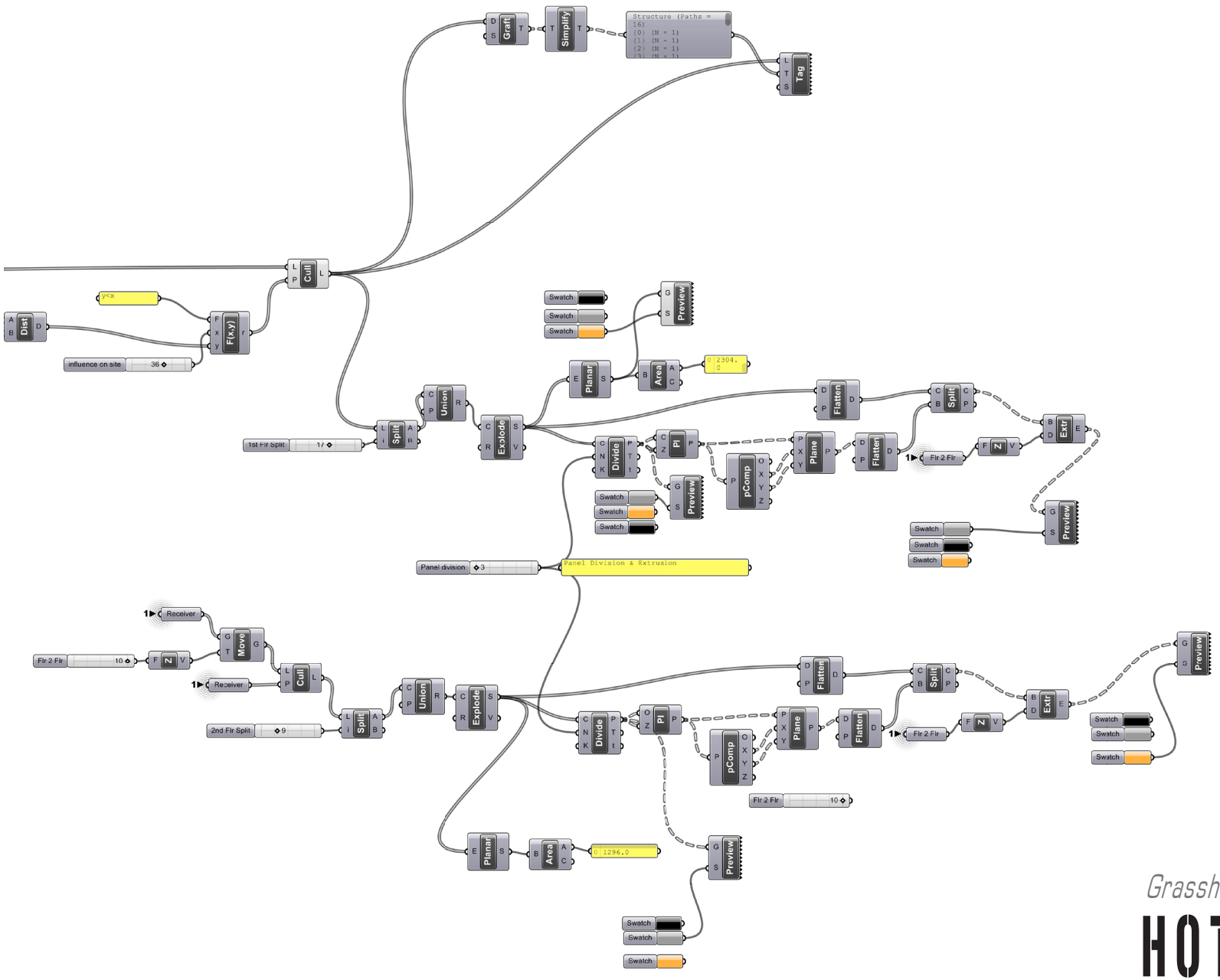
HOT SWAP

technology

Grasshopper Integration



The utilization of the Grasshopper plug-in for Rhino allows dynamic control of various constraints and components to be used with a Hot Swap system. By inputting the proper information into the model, selected inputs can be manipulated which produce multiple formal configurations. These configurations, with set constraints, can be rapidly updated to visualize future alterations. With this modeling system in place it is easy for the Hot Swap system to be visualized as it corresponds to the multiple ways it could be upgraded, downgraded, or modified as the users needs change.



Grasshopper Integration

HOT SWAP

technology

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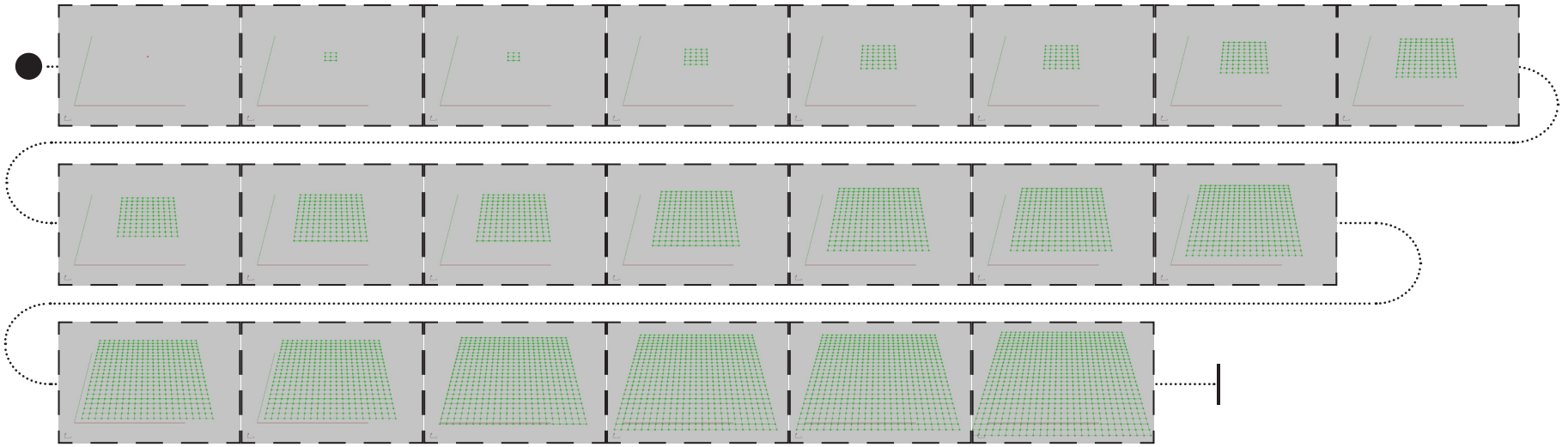
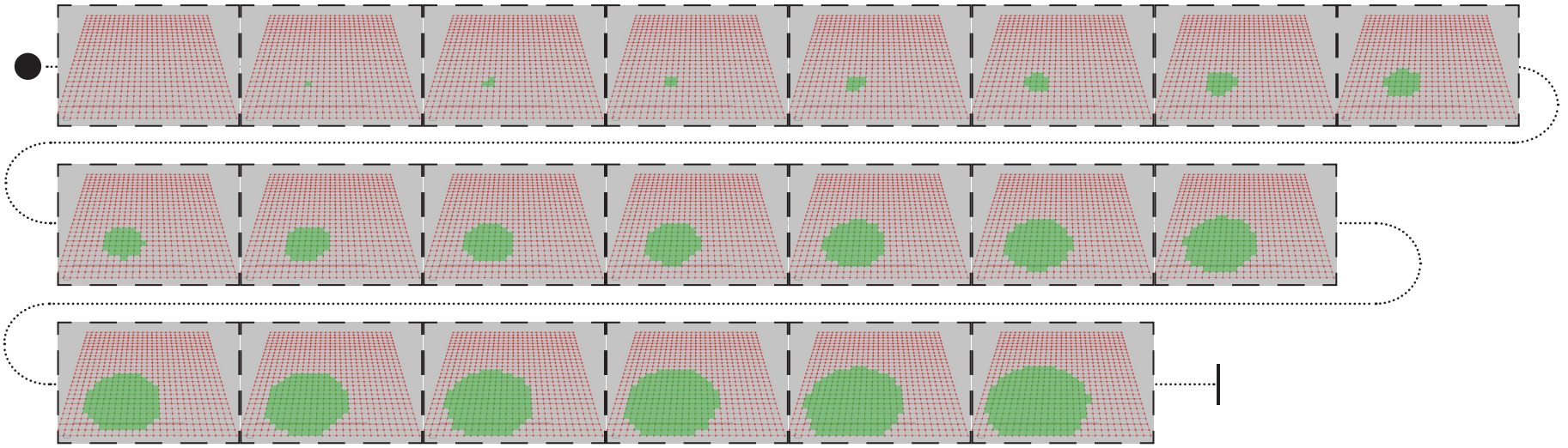
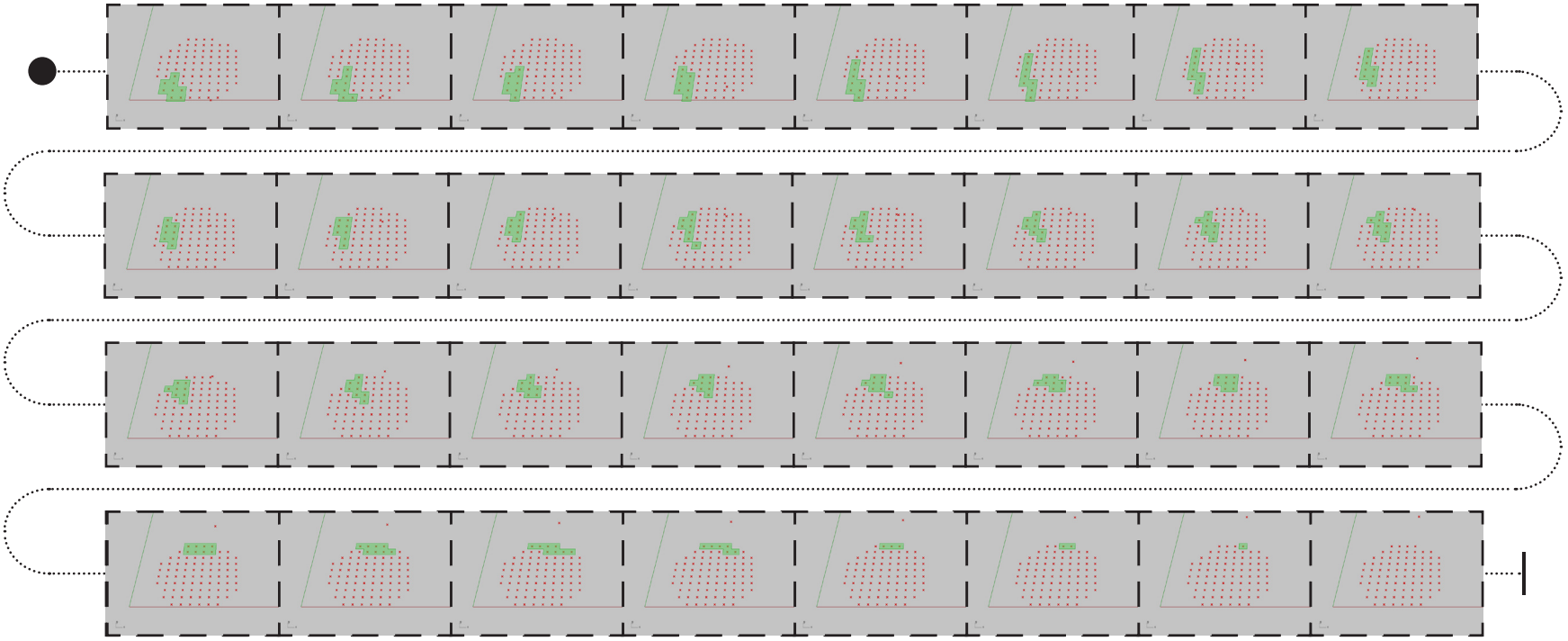
Dynamic Formal Configuration Control: Structural Grid



Dynamic Formal Configuration Control: Site



Dynamic Formal Configuration Control: Growth and Postion



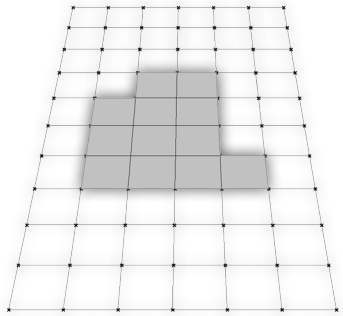
Grasshopper Integration

HOT SWAP

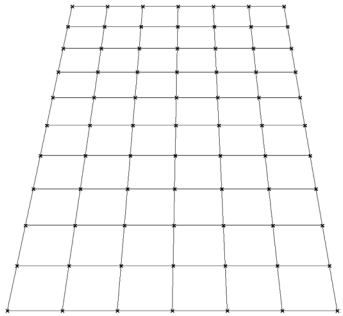
technology

formal configurations

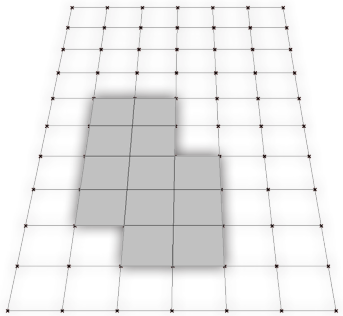
a. 1762 sq. ft.



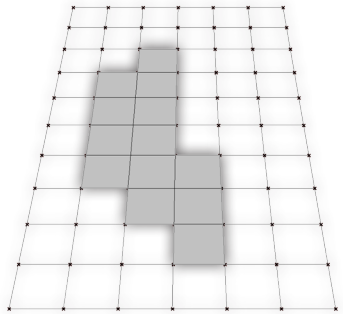
structural grid



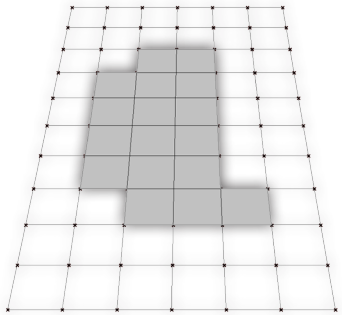
b. 1762 sq. ft.



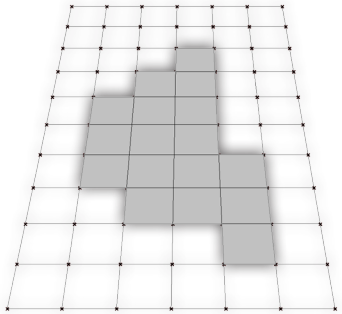
c. 1872 sq. ft.



d. 2448 sq. ft.

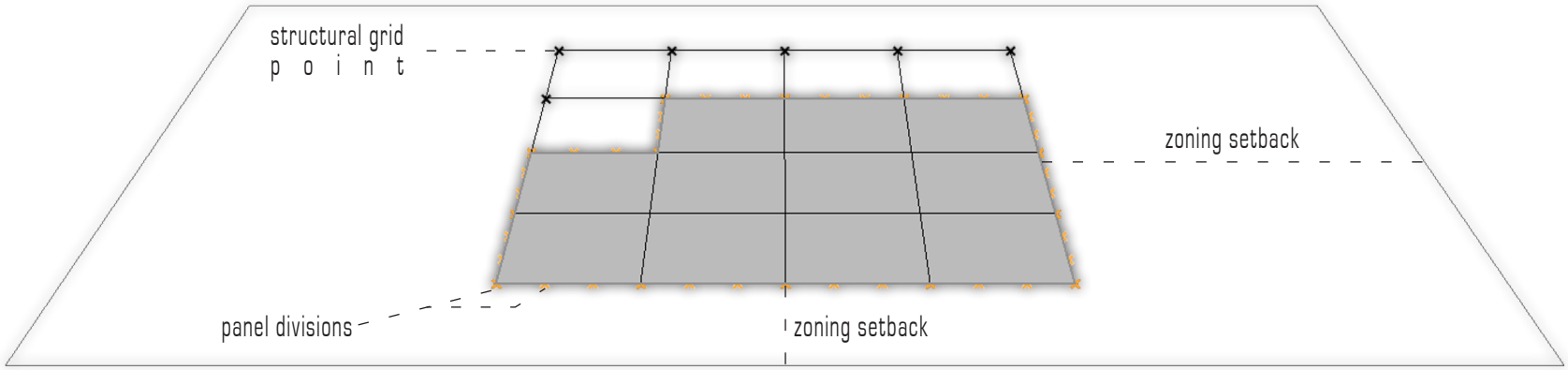


e. 2448 sq. ft.



1 _Once a site is selected, the dimensional parameters can be entered into the Grasshopper inputs. These dimensions are based on the parcel lot size dictated by the development. The structural grid point field can then be overlaid. The structural grid point field is spaced at 16' increments. This dimension is flexible to a degree; multiples of four are needed to comply with the panel size.

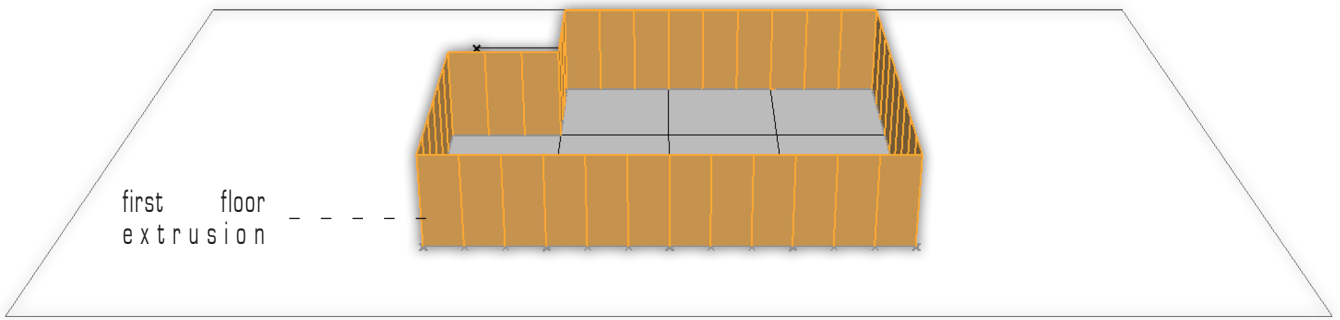
With the structural grid point field set, inputting the proper site setback information is necessary to comply with city zoning regulations for residential construction. After the setback information is entered, the buildable site is developed. This area is can be manipulated to develop multiple configurations, which can be used to forecast future development when changes in the users lifestyle permits.



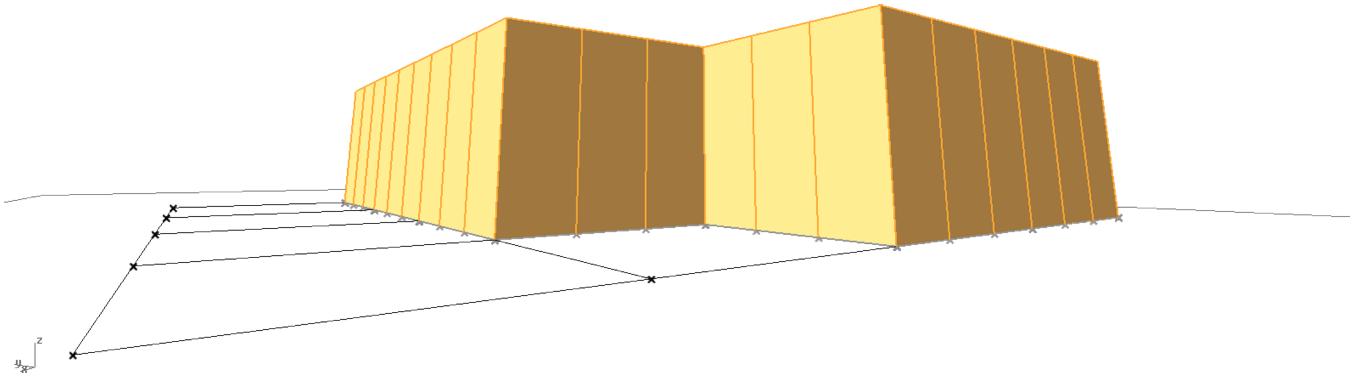
2_The division of the structural grid point field is arranged to allow flexibility. The system permits change by setting parameters to divide the space between the grid points.

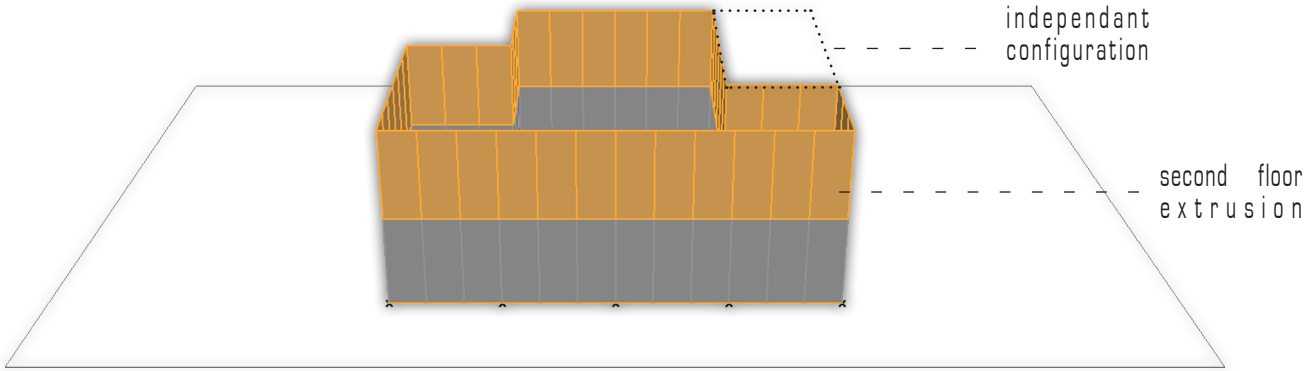
This example above is currently arranged to accept a 4' panel, but could be configured to accept a, 8', or 16' panel. This space will allow for the system to either adopt large sections of panel assemblies, or single panels.

This flexible configuration aids the overall composition of the system by providing the ability to remove individual sections of panels as needed.

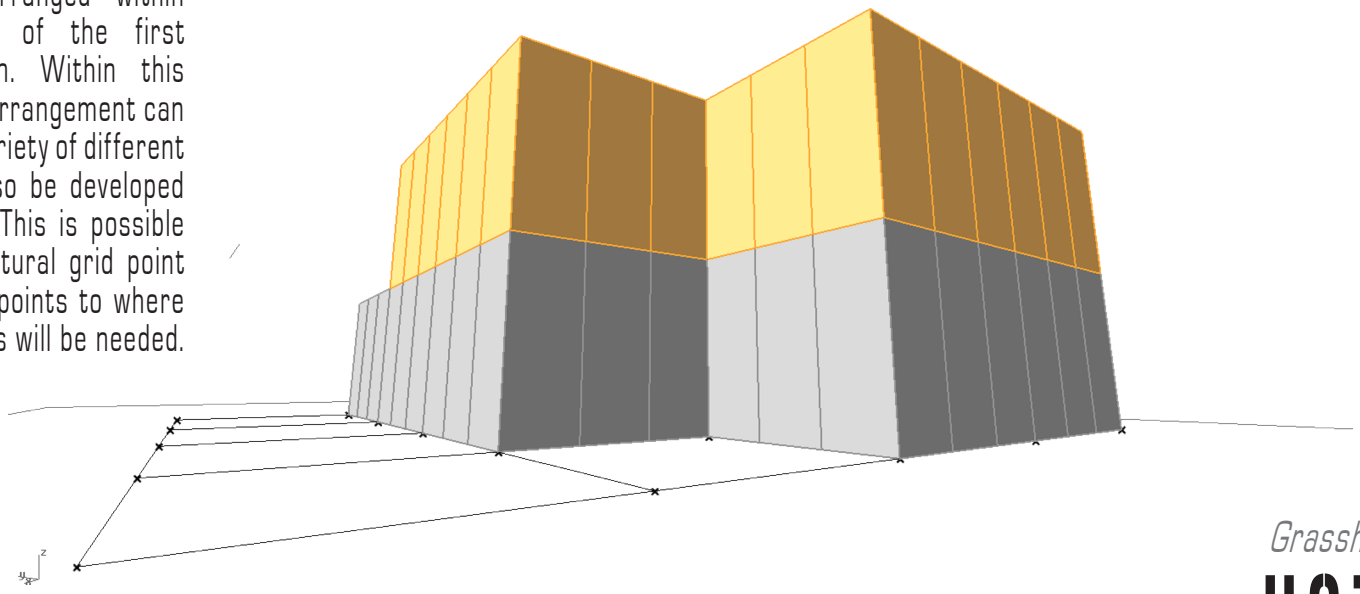


3_The divisions from the structural grid spacing allow for the panel configuration to be extruded from these exact locations. The amount of extrusion is a flexible parameter which can easily be modified to a specific height. This extruded height can be developed to situate a structure which is composed of only one floor, thus providing a base for a roof system. An additional configuration exists by allowing the extrusion height to act as structure support for a second floor.





4_The second floor configuration is semi-dependent on the first floor configuration. The arrangement can be manipulated to develop a separate assembly which can be arranged within in the boundary of the first floor configuration. Within this configuration the arrangement can be displayed in a variety of different designs. It may also be developed on its own merit. This is possible by using the structural grid point field as indication points to where structural supports will be needed.



1st Semester Iterations

Panel Break-down

Structure Break-down

Assemblage

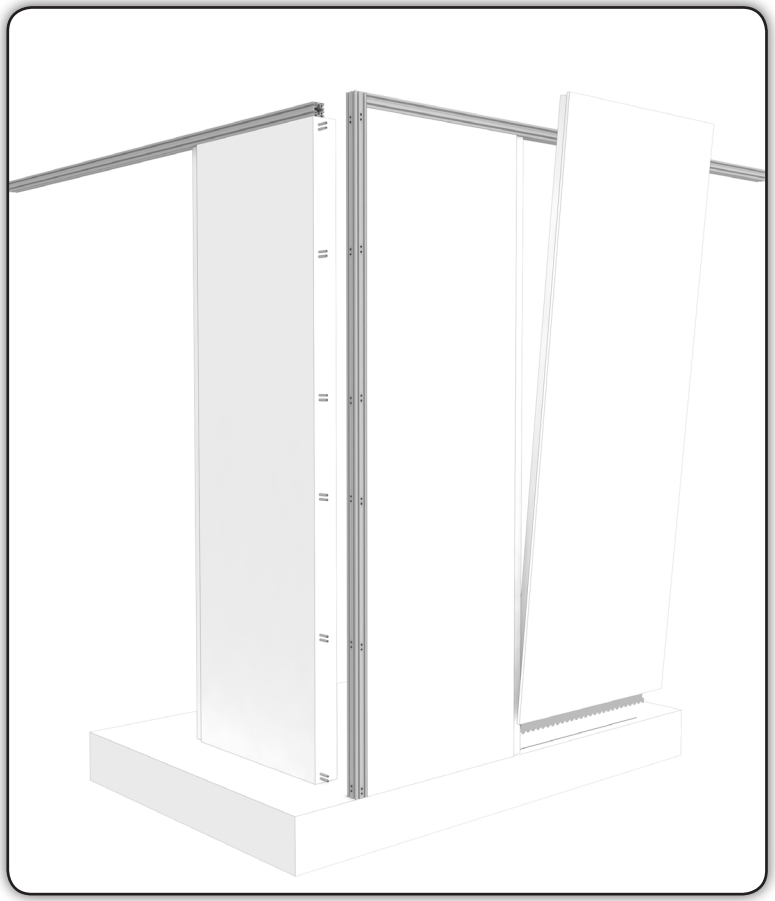
Panel Swap Process

Growth of the Home

Final Designs

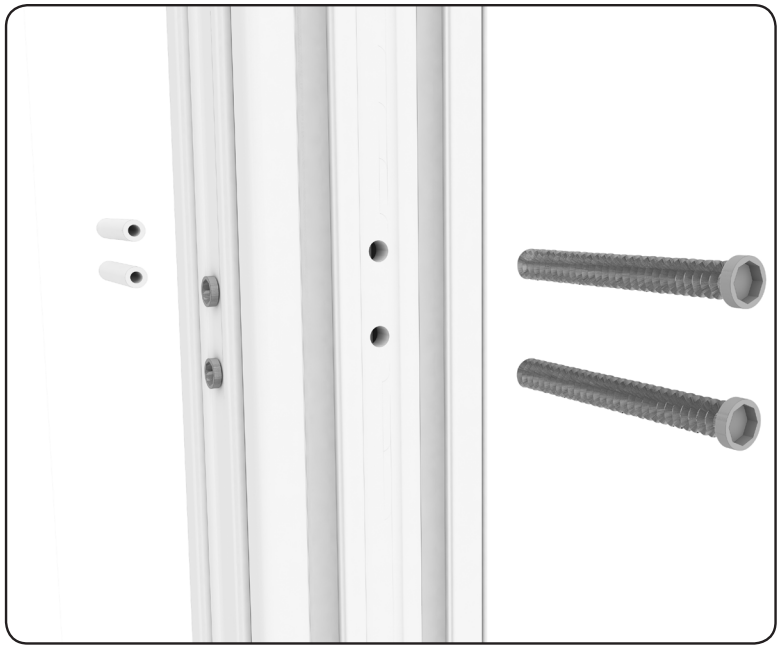
HOT SWAP

design

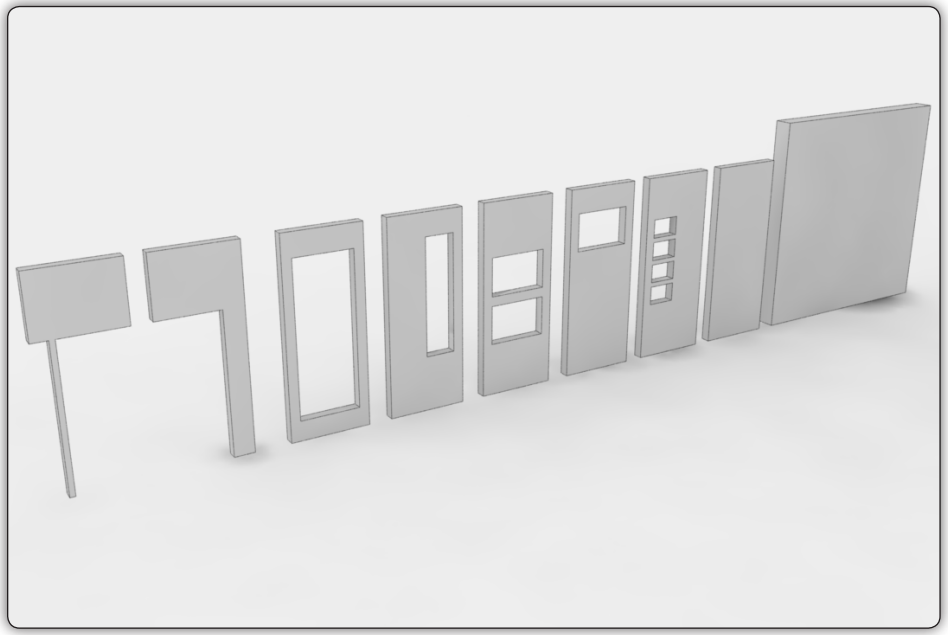


connection to column

connection to floor plate



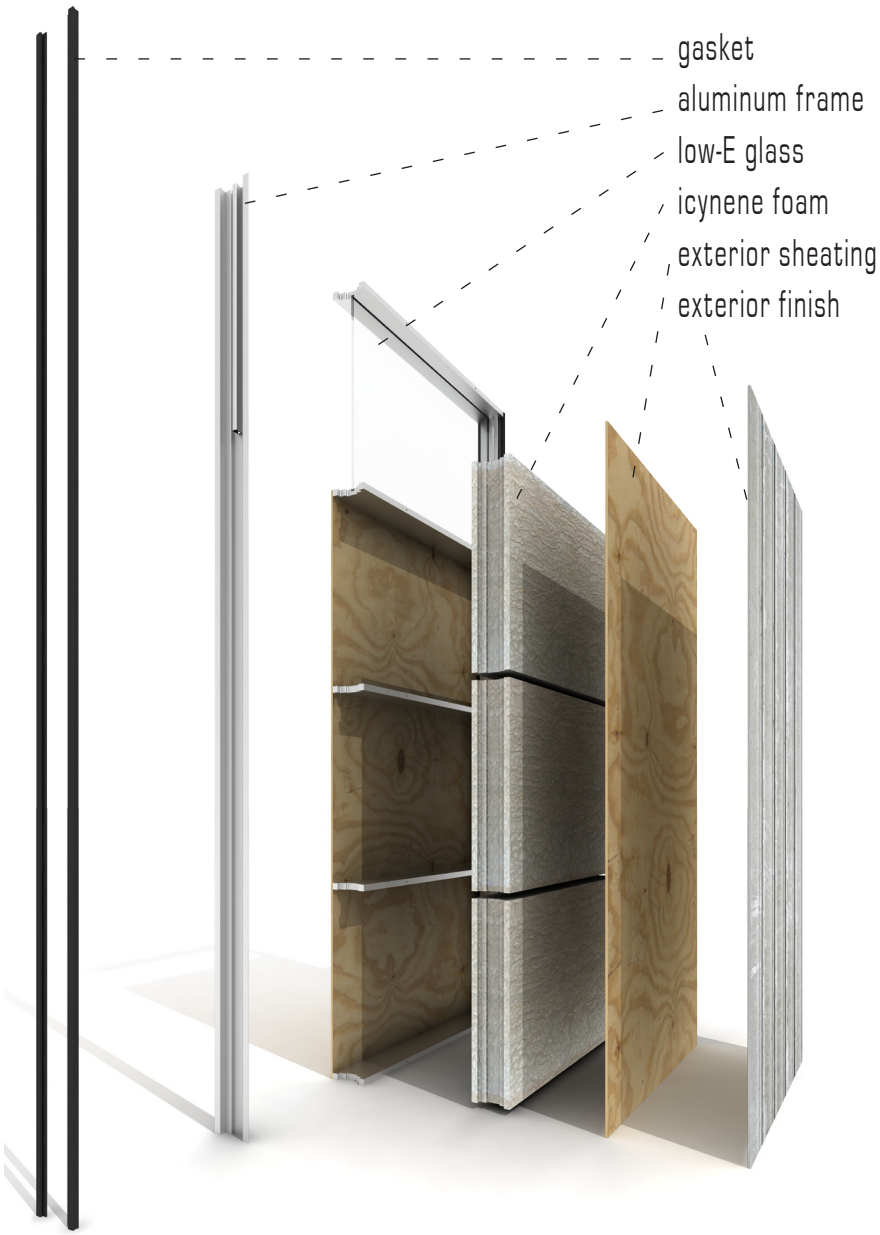
connection to column (detail)



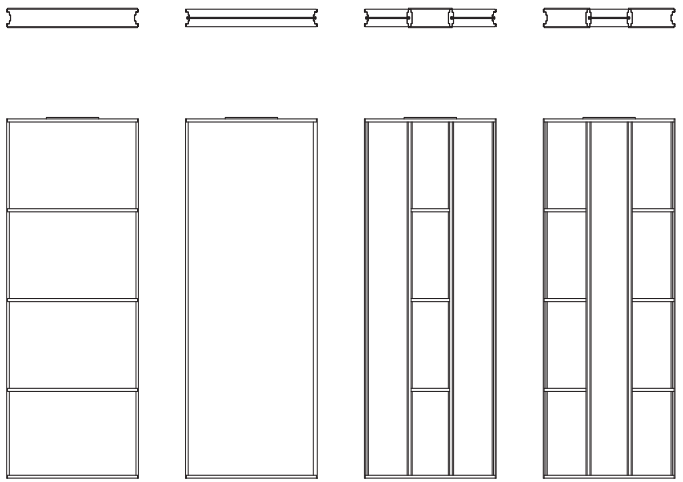
panel types

initial panel configuration

Panel Break-down



Panel variations

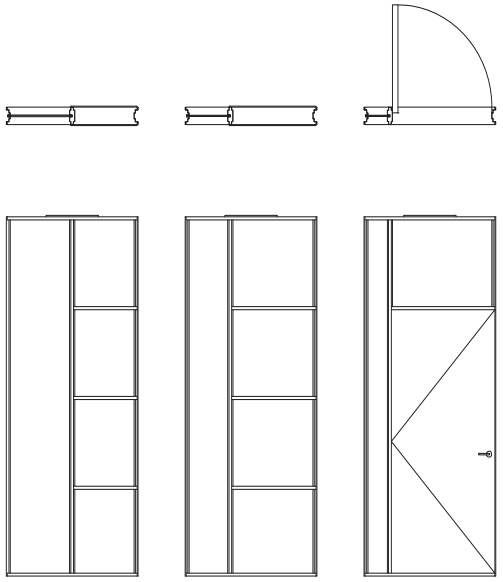


The Hot Swap panel plays the key role in developing a home which can be upgraded/downgrade or repaired. With out the panel the Hot Swap system is non-existent, and the system is reverted back to a strictly module based system.

For the Hot Swap panel succeed it need to accomplish these goals; be easy to install and have the flexibility to attain multiple configurations.

1 _ *ease of install*

The Hot Swap panel has two components which secure the panel from movement and prevent environmental elements from penetrating, the locking gasket and the locking mechanism. The locking gasket forms a tight seal between connections from a panel to panel, or a panel to column. This gasket would be replaced and renewed each time a panel is swapped. The locking mechanism is located on the upper most portion of the panel, and only accessible from the interior portion of the home. This is to prevent would be thieves from removing portions of the home.



Leasing Options

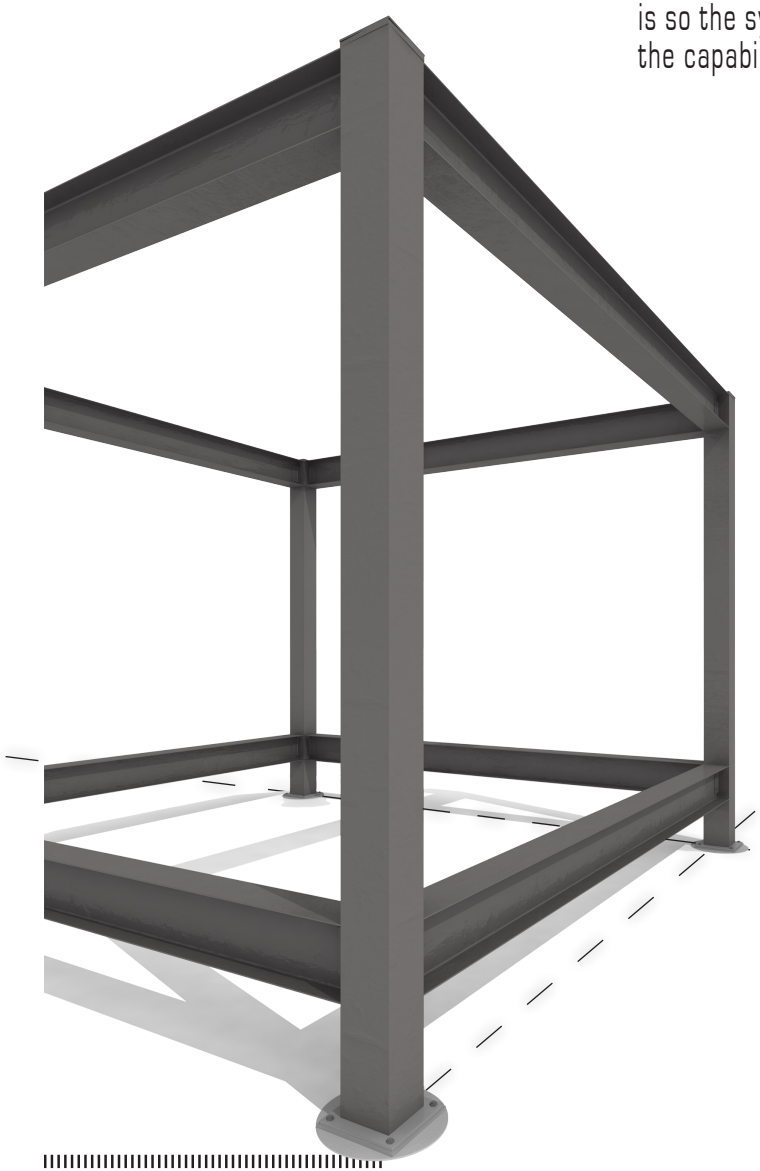
With the Hot Swap system the home owner never owns the panels. The panels are leased to the consumer. This is so that the Hot Swap panel can always be upgraded to the most efficient materials on the market. With the leasing structure in place consumers can always guarantee that the materials used in their home are the most energy efficient and environmentally friendly. Leasing also provided the consumer the option of removing portions of their home and trading it in during tough financial times.

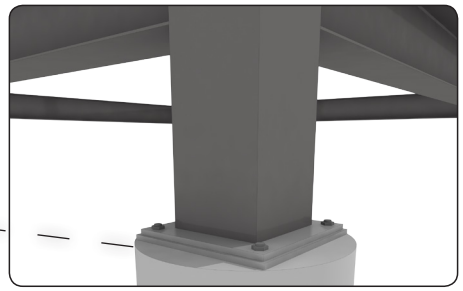
2_*multiple configuration*

The Hot Swap panel has been design so that multiple configurations can be achieved, which results in a variety of architectural possibilities. The panel can be developed to achieve any particular type of opening one might want.

Panel Break-down

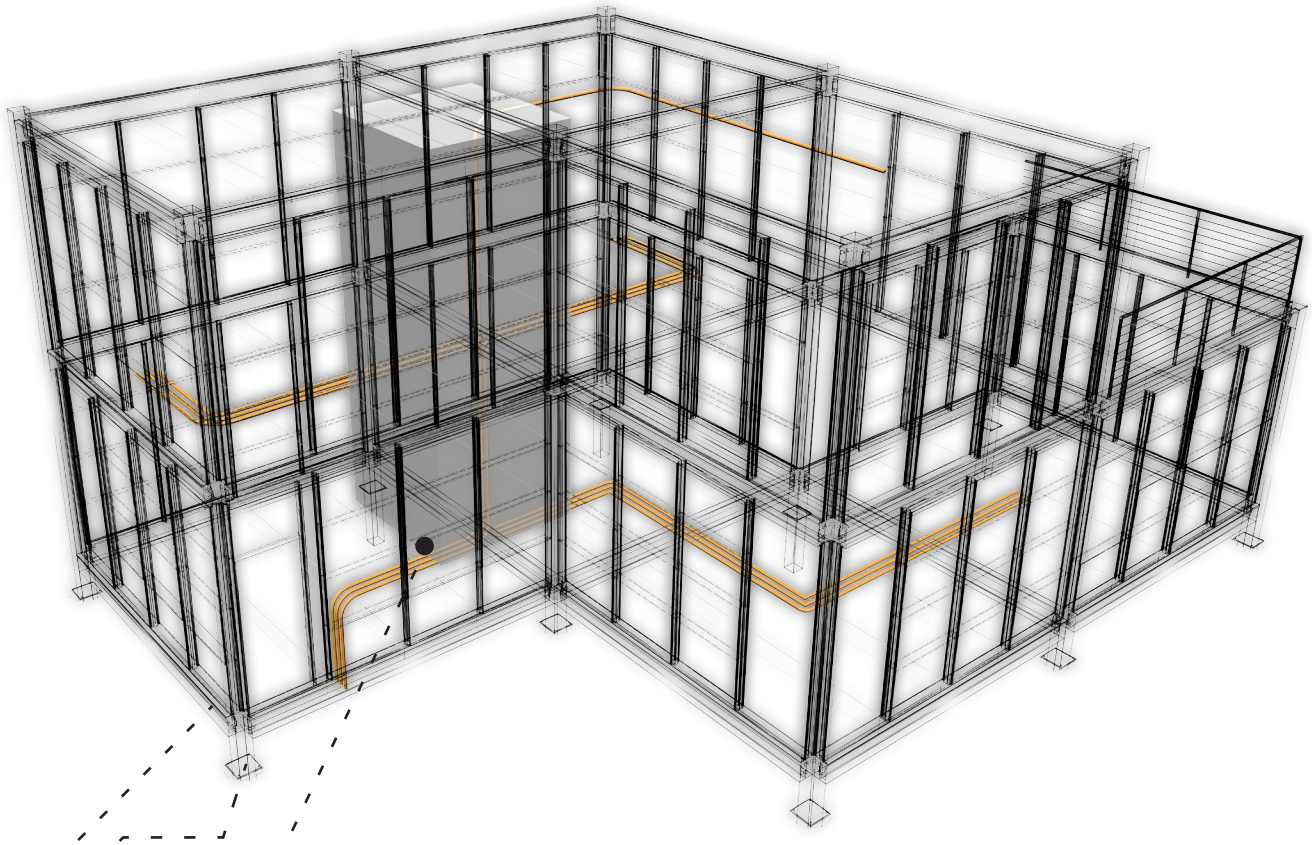
The structural system for the Hot Swap system is composed of HSS steel columns and W-shaped steel for beams. The connection type between the two structural members needs to be bolted connection. This is so the system can be easily installed into the structural foundation points. Also the system needs have the capability of disassembly in the event the home owner wishes to upgrade or downgrade their home.





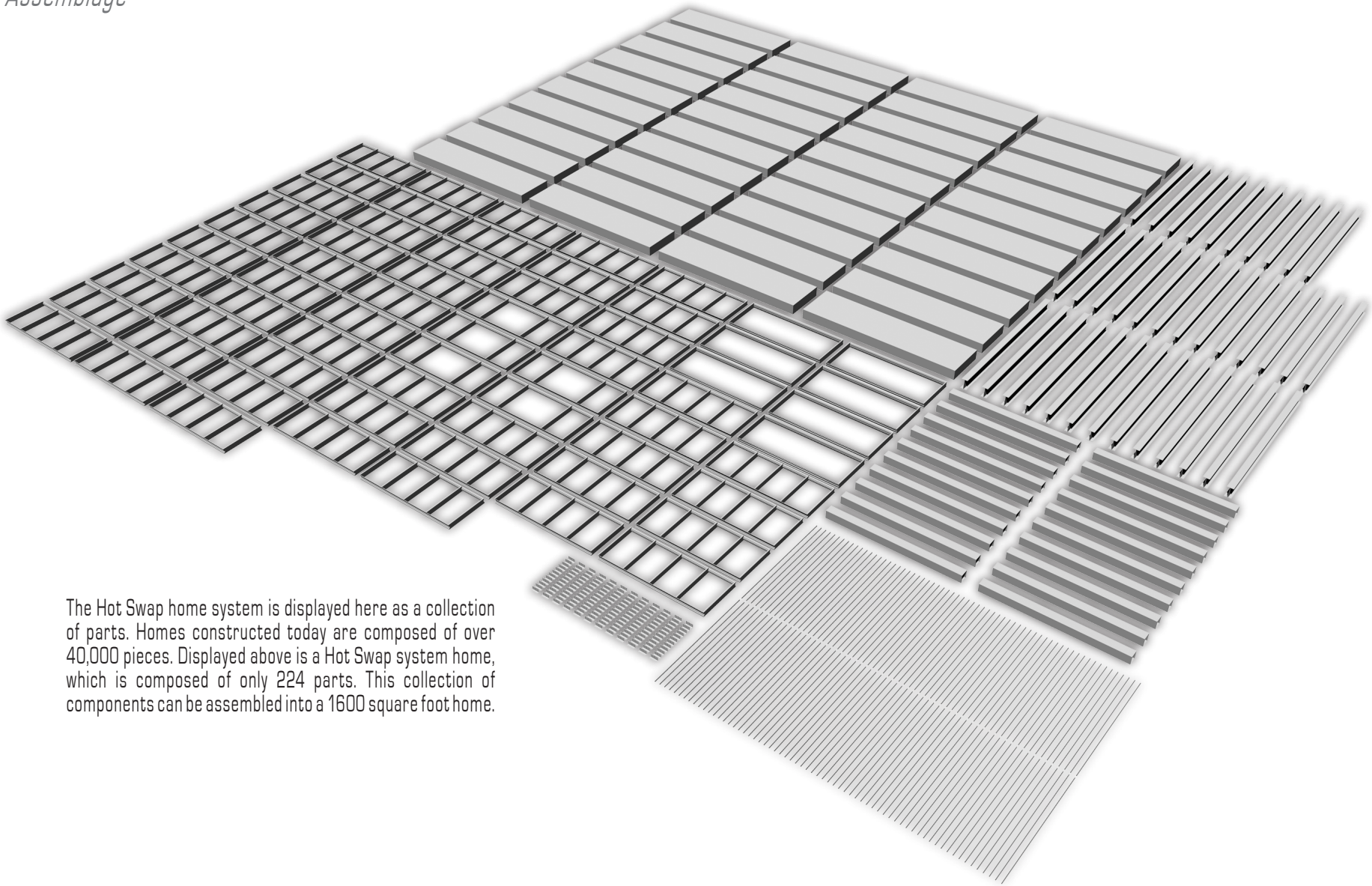
connection to footing

The core within the Hot Swap system provides a fixed centralized location for services to enter the residence. The nature of the core allows the system to still be flexible in the event of a system change. The core supplies all necessary HVAC, plumbing and electrical services to the residence through the floor panels.



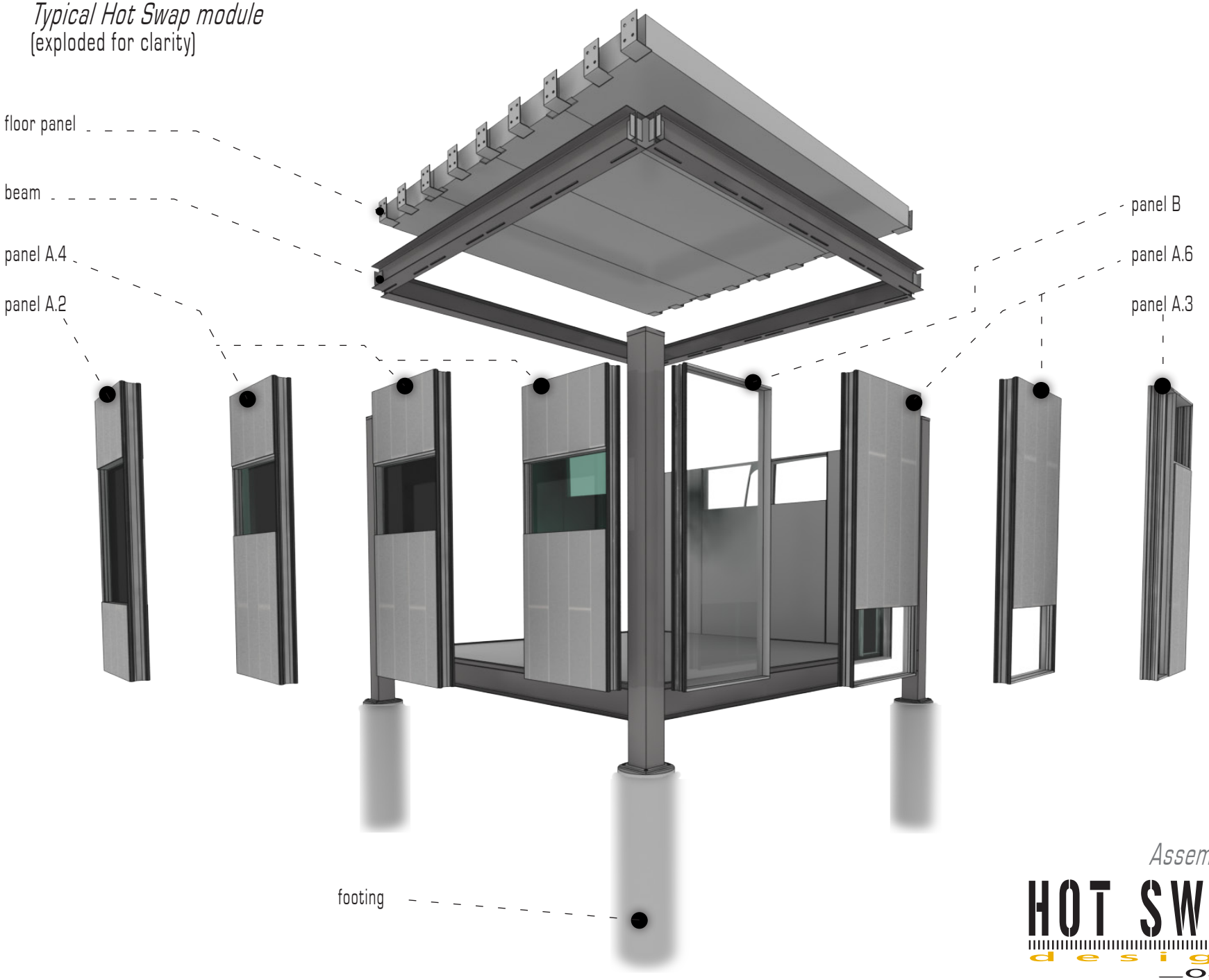
Hot Swap System

panels
structure
core



The Hot Swap home system is displayed here as a collection of parts. Homes constructed today are composed of over 40,000 pieces. Displayed above is a Hot Swap system home, which is composed of only 224 parts. This collection of components can be assembled into a 1600 square foot home.

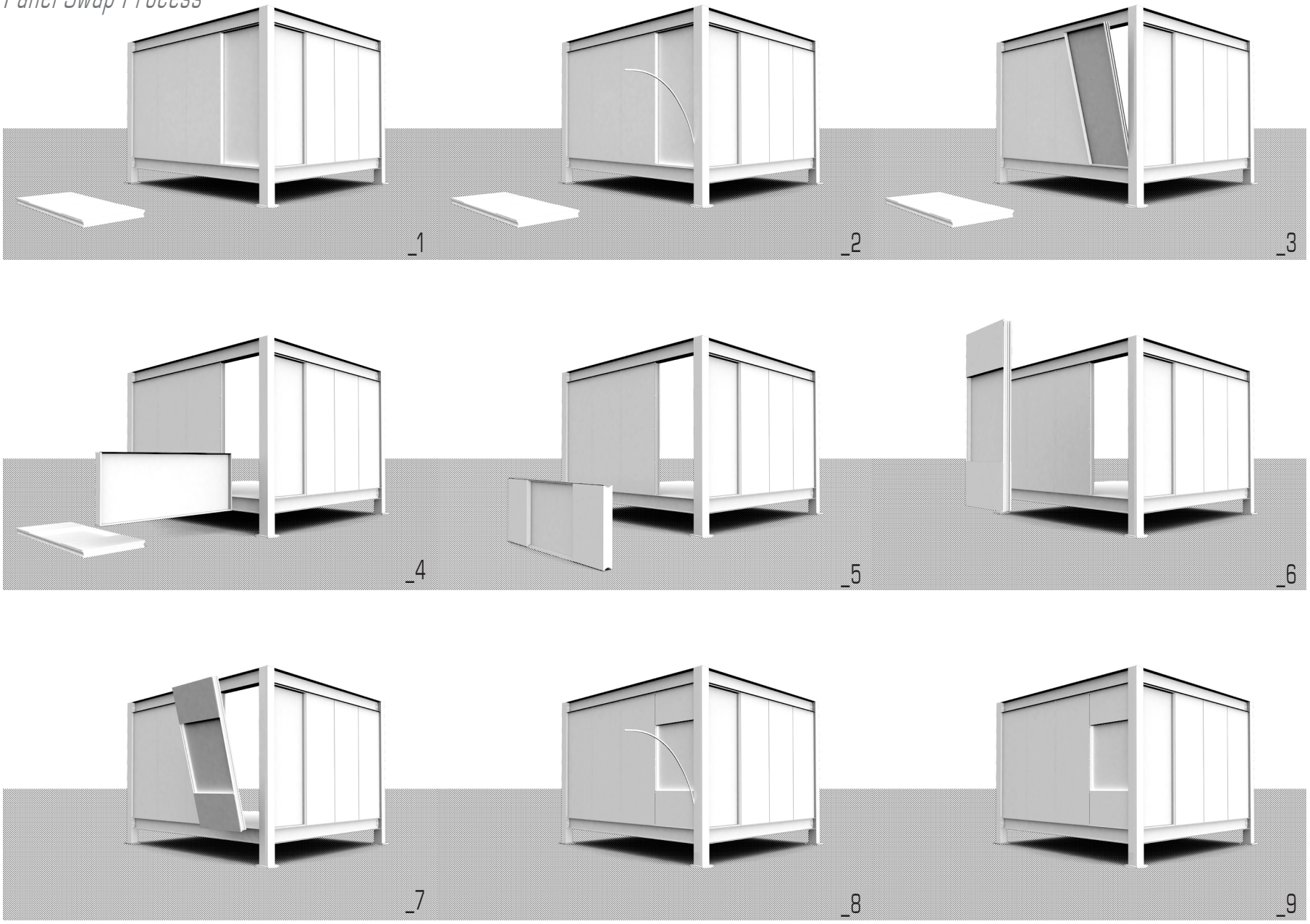
Typical Hot Swap module
(exploded for clarity)



Assemblage

HOT SWAP
design
_044

Panel Swap Process



(left) _Swap Steps

_1_unlock panel from inside house.

_2_remove locking gasket from the exterior side of the panel.

_3_tip out and remove panel.

_4_return panel to Panel store for credit.

_5 & 6_lift new panel into place.

_7_tip panel up into previous location.

_8_install new locking gaskets

_9_lock panel from inside the home.

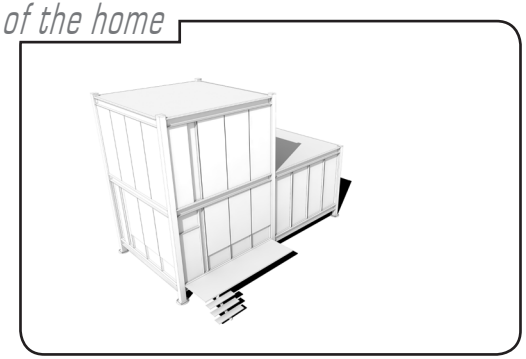
(right)_Detail of locking to beam

_1_ locking assembly shown with the locking mechanism in the locked position.

_2_locking assembly shown with locking mechanism in the unlocked position.

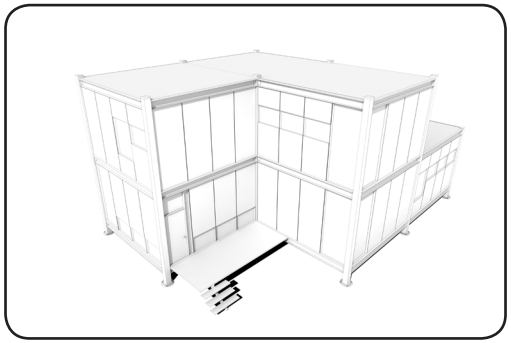
Panel Swap Process

HOT SWAP
design
_046

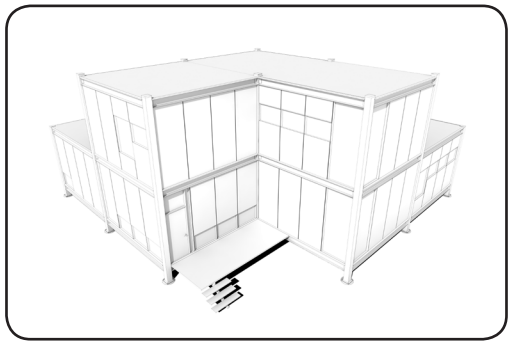


768 sq. ft.

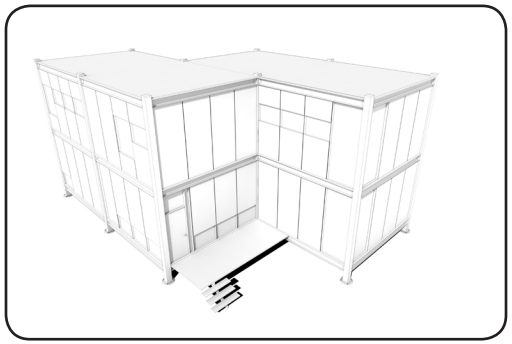
1280 sq. ft.



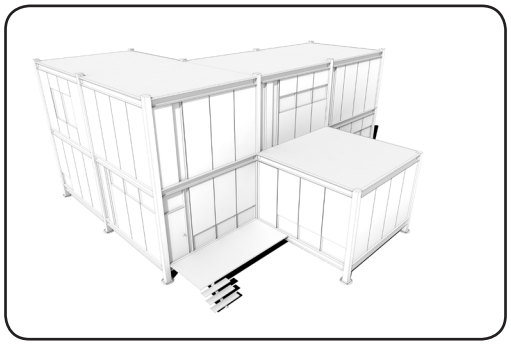
1536 sq. ft.



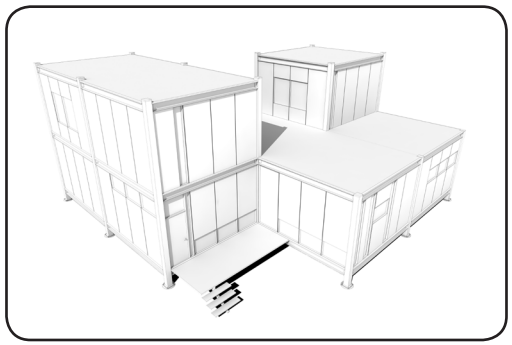
1792 sq. ft.



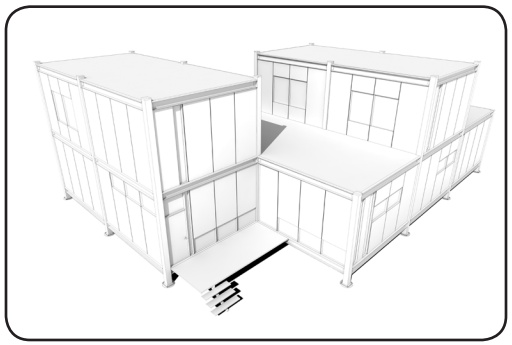
2048 sq. ft.



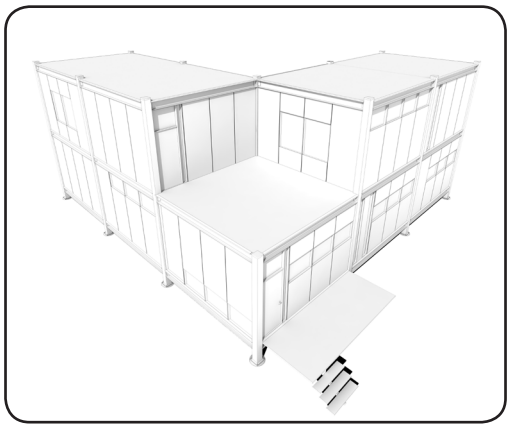
2304 sq. ft.



2304 sq. ft.



2816 sq. ft.



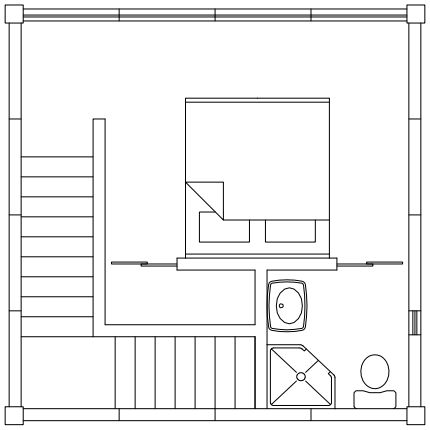
3072 sq. ft.

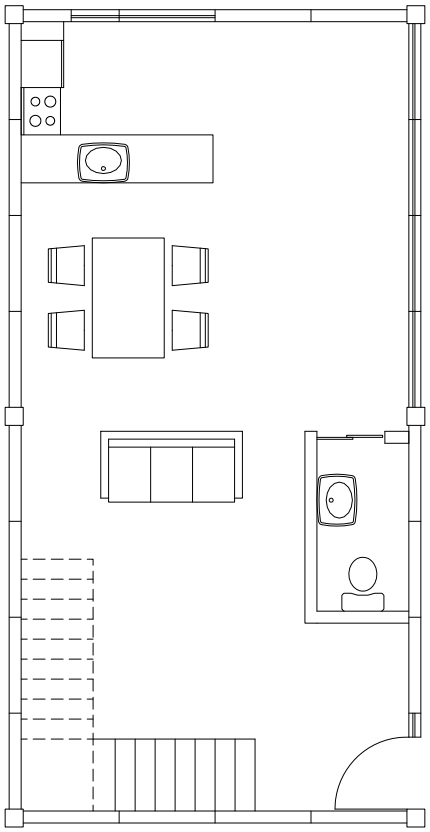
Growth of the Home

HOT SWAP

design

second floor
scale = 1/8" = 1'





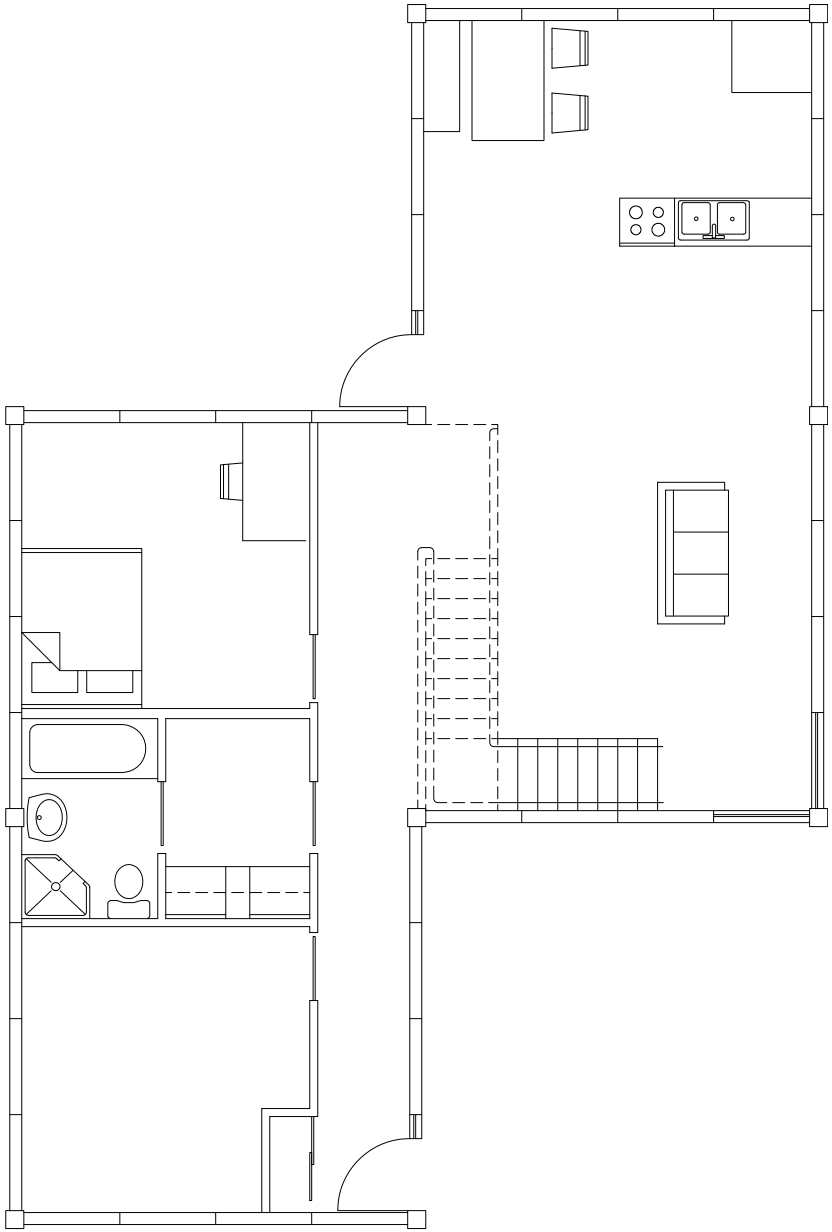
first floor
scale = 1/8" = 1'

Final Designs

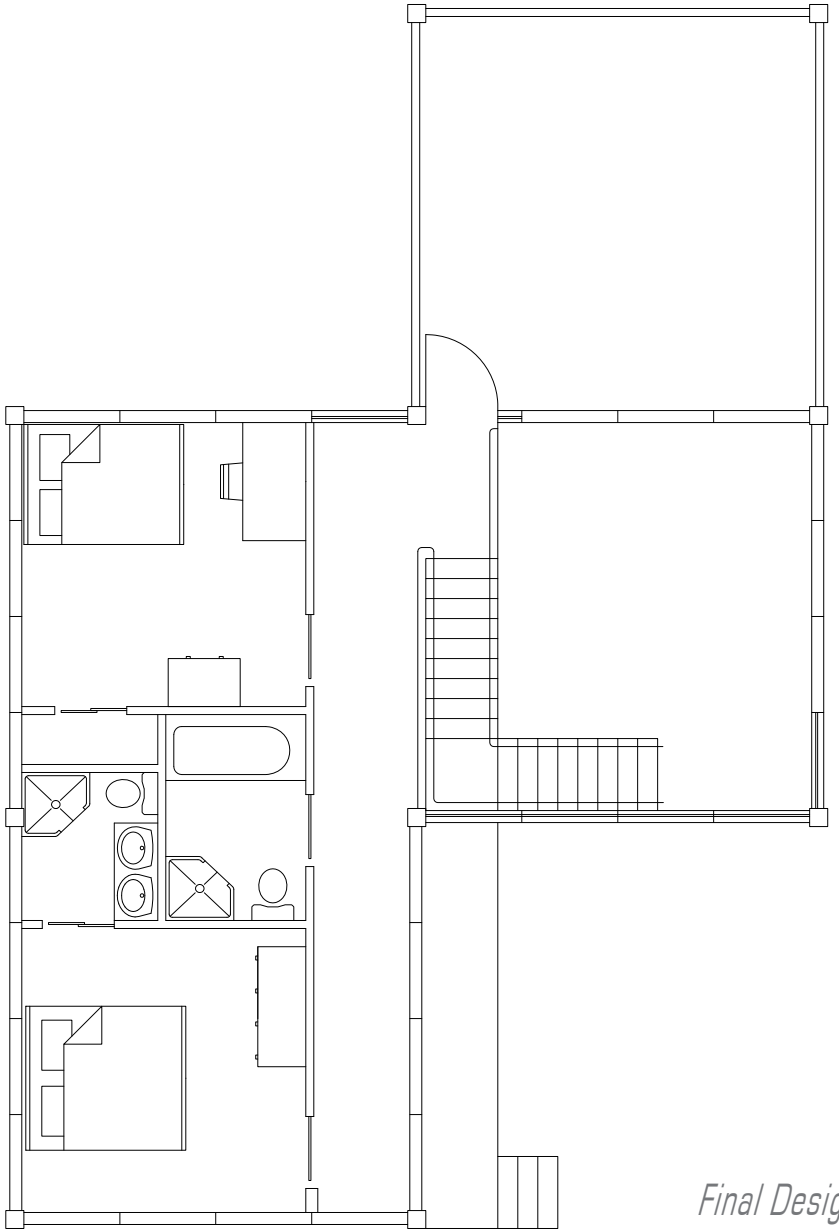
HOT SWAP

design

_050



first floor
scale = 1/8" = 1'



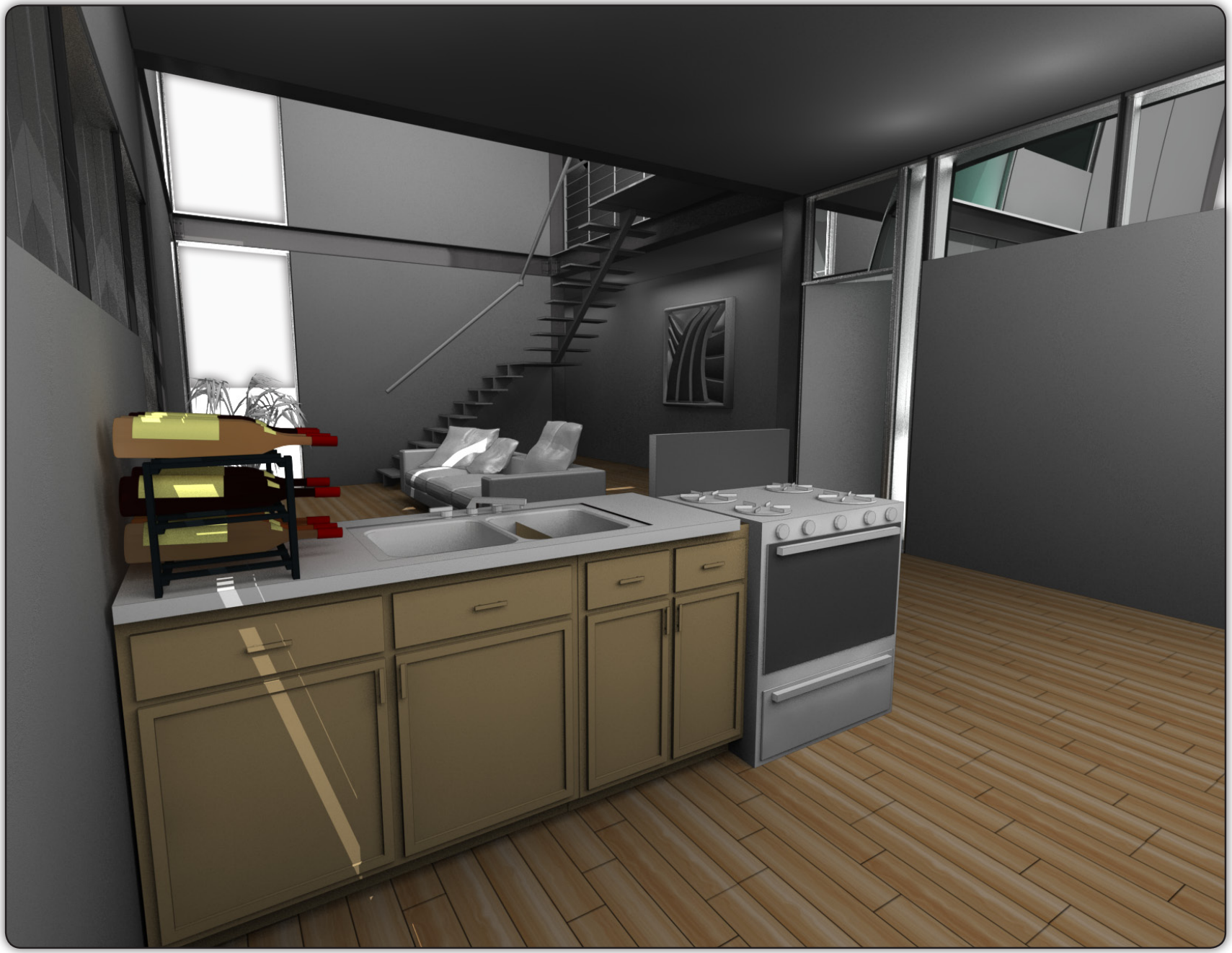
second floor
scale = 1/8" = 1'

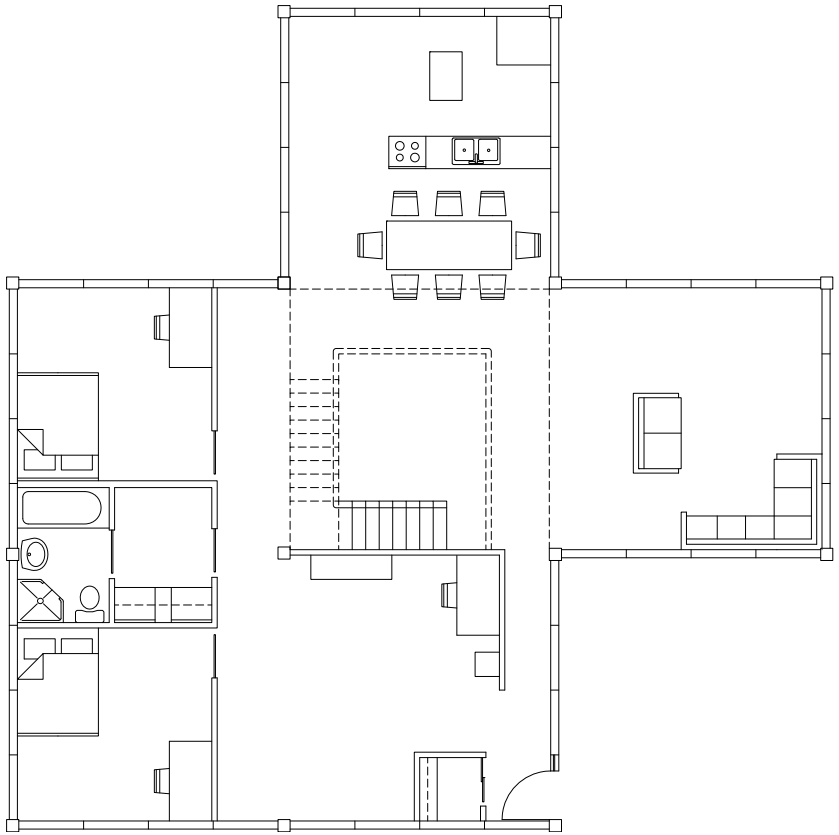
Final Designs

HOT SWAP

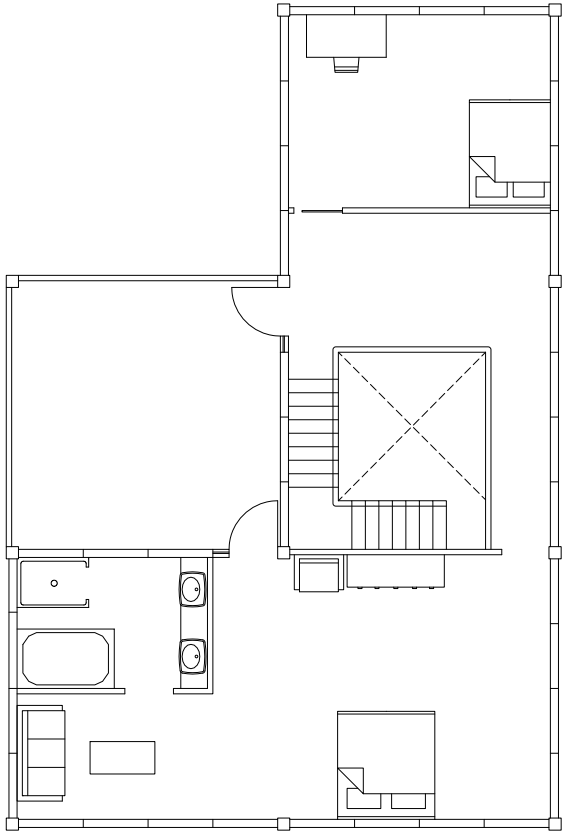
design

_052





first floor
scale 3/32" = 1'



second floor
scale 3/32" = 1'

Final Designs

HOT SWAP

design

_056

Anderson, Mark. Prefab Prototypes: Site-Specific Design for Offsite Construction. Princeton Architectural Press: New York. 2006

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Thornton, Rosemary. The Houses That Sears Built. Gentle Beam Publications: New York. 2004

I would like to thank my mentor Steve Hardy for his knowledge, guidance and extreme patience assisted me throughout this epic adventure of generating a thesis. His determination to help me succeed and advice on topics outside of the realm of architecture have been extremely helpful. Guiding me through this process couldn't have been easy at times.

Thank you to the Architecture Faculty and Stephanie for all the advice and assistance through the last six years.

Huge thanks to all of my studio mates! Throughout the last six years you have helped me throughout. Your confidence and laughter helped me through the toughest of times. The memories we generated over the last six years will keep me laughing forever.

To my family and friends, thank you for believing in me when I needed it. Your support in the form of hugs, beer, and cash gave me a well needed boost when I was all outta gas.

And finally, thank you to my best friend, wife, biggest supporter, Jill. Without you this would have been impossible. For all you've sacrificed over the last six years, I will spend the rest of my life trying to make your life as easy as you've made mine. Without you in my life none of this would matter. Thank you for pushing me when i didn't feel like moving...